SAFFORD

Losses of Nutrients in Cooking Potatoes

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Losses of Nutrients Involved in Cooking Potatoes

BY

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THESIS

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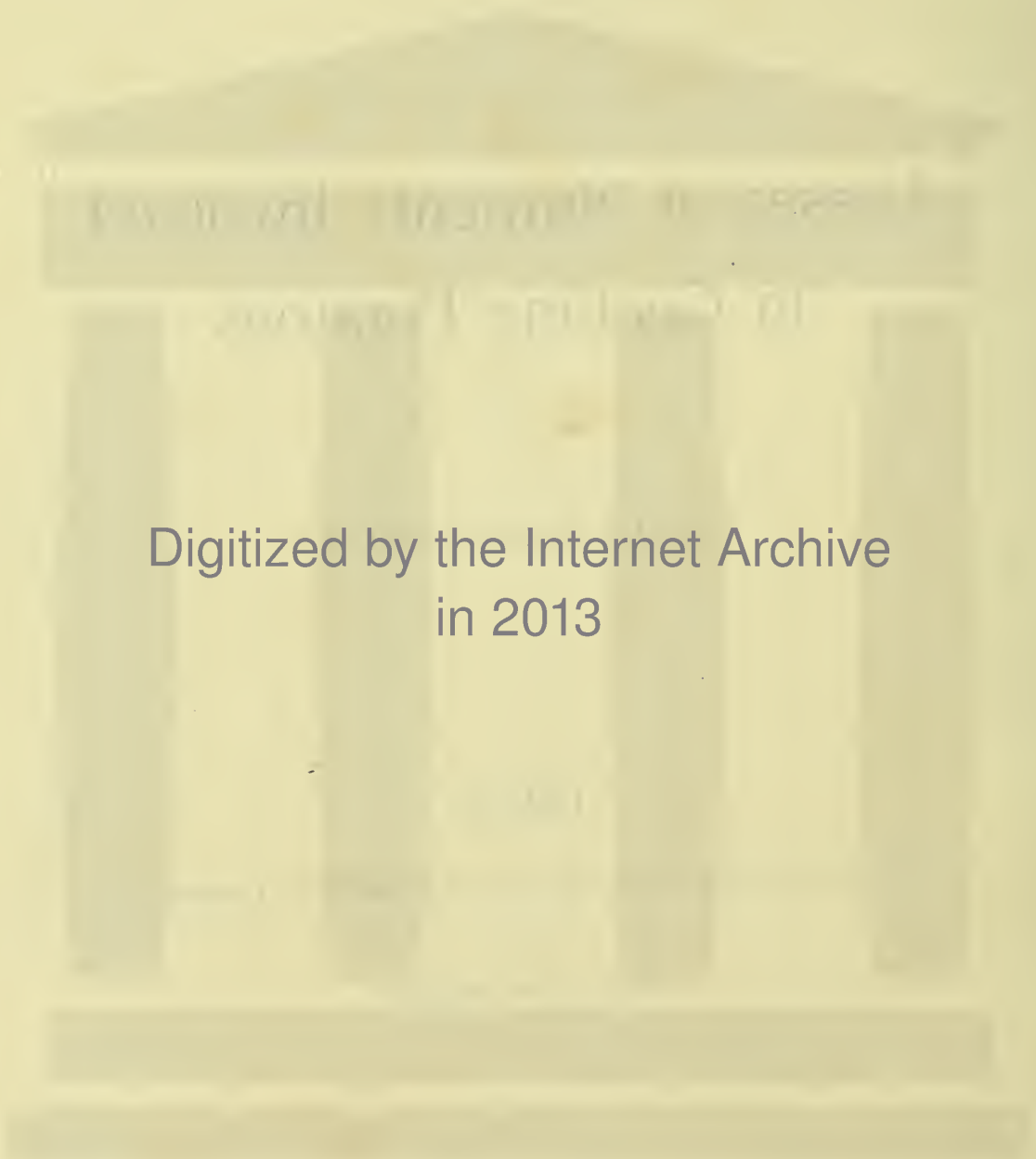

UNIVERSITY OF ILLINOIS

June 1st, 1900

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Edward D. Safford

ENTITLED The Losses of Nutrients involved in the cooking of Potatoes,

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Chemistry.

Alfred W. Palmer.

HEAD OF DEPARTMENT OF Chemistry.

The potato, because of the immense quantities of it used for food, and for various industrial processes, such as the manufacture of starch, merits a more exhaustive analysis than it has thus far received. This is especially true in regard to the effects of cooking.

Between the years 1865 and 1898 the annual production of potatoes in the United States was between one hundred and three hundred million bushels, the production being much larger in the northern states. This annual crop has varied from sixty to a hundred million dollars in value.

Analyses of potatoes are recorded as early as 1840. These analyses consisted cheifly of the determination of the ultimate constituents, and of the amount of mineral and vegetable matter present. On account of the incomplete methods of analysis of vegetable matter known at that time, but few attempts were made at a proximate analysis of the potato. However it should be mentioned that previous to 1860 estimates of the starch were made from the specific gravity and from these estimates tables were compiled showing the relation of the percentage of the starch to the specific gravity.

During the year 1878 Schultze and Barbieri (Jahres Bericht 1878 p.961) investigated the nitrogen contained in potatoes by means of the soda-lime method, and stated as a result of their labors that the nitrogen existed partly as so called protein and partly as amid-nitrogen in asparagine and kindred bodies. In 1882 Schultze and Engster determined nitrogen and the forms in which it existed in the juice obtained from four kinds of potatoes. According to their results, the albuminoid nitrogen varied from 44% to 65%, and the amid-

nitrogen from 56% to 35%. The question of the form in which the nitrogen exists in the potato has been investigated quite thoroughly since that time, and improved methods of separation devised; but beyond the fact that amid nitrogen always occurs partially in asparagine, tyrosine and leucine, and remainder in the so-called protein, nothing definite is known.

The relation between the amount of starch and the specific gravity of the potato has been worked out rather completely; but it is not regarded as a strict enough relation to justify its use for accurate quantitative determinations. A considerable number of the analyses have been made to show the difference in composition of the numerous varieties of potatoes. The Ninth Annual Report of the West Virginia Experiment Station containes analyses of about one hundred varieties of potatoes grown in that state. From this article there seem to be no general conclusions that can be drawn about the differences between early and late potatoes, but from analyses made by H. Condon and L. Bossard and reported in the Annalen der Science it seems that the early varieties contain more water and nitrogen and less starch than the later varieties. The difference between the two is not usually more than one or two per cent of the amount of water present. The New York Experiment Station Record no. 11 gives analyses showing that small potatoes are higher in water and ash by about two per cent and lower in starch than are large potatoes.

The effect of various fertilizers upon potatoes has been investigated by Sewell and Menke, and reported in the American Chemical Journal vol. 9 p. 103. These investigators tested potatoes

with all the common kinds of fertilizers. Their analyses do not show any greater difference in the potatoes so treated than might be explained by ordinary errors of analysis.

Voohrees, chemist of New Jersey Experiment Station, in Bulletin 80 of that station reports some of his investigations on the action of fertilizers and on the best method of cultivation. His conclusions are as follows: the largest yield of potatoes is obtained where a mixture of barnyard and chemical manures is used, by far the most valuable chemical fertilizer is potassium sulphate, and the fertilizer affects the composition of the potatoes. Besides the direct increase in the number of the potatoes produced by a given area their size is increased by fertilizers, and as previously mentioned, large potatoes are higher in starch than small ones. Nevertheless, Voohrees states that the increase of dry matter in not proportional to the increased weight produced by fertilization. When potassium sulphate is used, the dry matter falls 3.1%, when potassium chloride is used 7.5% and when potassium nitrate is used 11.8%. All of them however, increase the per cent of nitrogen. Thorough cultivation increases the yield and is supposed to improve the composition, but the data on this point is not sufficient for any conclusive statement.

The number of complete analyses of potatoes published up to the present time is very large, and very reliable results are obtained by averages of these analyses such as are published by Atwater and Bryant in Bulletin 28 U. S. D. A. and Jenkins and Winton in Experiment Station Bulletin 2 .

	Water	Protein.	Fat.	Total Carbohydrates.	Fibre.	Ash.
Atwater & Bryant.	73.30%	2.20%	.10%	18.40%	.40%	1.00%
Jenkins & Winton.	78.89%	2.14%	.10%	17.36%	.56%	.95%

While a large number of analyses of raw potatoes heve been made, the analyses of cooked potatoes are limited in number. Atwater and Bryant in Bulletin28, United States Department of Agriculture gives the average of eleven analyses of boiled potatoes. Since the time of boiling and the general data of the cooking experiment are not given the results have but little significance.

Water.	Protein.	Fat.	Total Carbohydrates.	Fibre.	Ash.	Fuel Value per lb.
75.50%	2.50%	.10%	20.90%	.60%	1.00%	440

Miss K. J. Williams, a fellow of University College, Bristol made analyses of a number of kinds of cooked vegetables, and among them potatoes. Her results are reported in the Journal of the London Chemical Society vol. 61 p.326. She made analyses of the ultimate constituents of the potato and determinations of its heat of combustion.

Ultimate Analysis.

	Ash.	Hydrogen.	Carbon.	Nitrogen
Pgtato(boiled with skin).	4.85%	5.75	40.07	2.04
Potato(boiled without skin).	2.95	5.39	35.50	2.40

The low per cent of Carbon in potatoes boiled without the skin is rather noticeable.

Miss K. J. Williams Results.

Potatoes boiled in skin.	Water.	Ash	Albuminoids	Woody Fibre	Fat	Cellulose	Glucose	Potassium Nitrate
	73.80%	1.27	1.62	.49	.03	4.50	20.81	.08

Results from Konig's "Die Menschlichen Nahrung and Genussmittel".

	Water	Ash	Albuminoids	Woody Fibre	Fat	N. Free Extract.		
Potato.	75.45	.98	1.95	.75	.15	20.69		

Results from "Food" by Prof. Church.

	Water	Ash	Albuminoids	Cellulose	Fat	Starch	Extractives	Dextrin
Potato.	75.0%	1.	1.2	1.0	.03	18.0	1.50	2.0

Heats of Combustion.

Potato boiled in skin 4072.6 Calories of heat.

Potato boiled without skin 3819.0 Calories of heat.

By far the most reliable and extensive investigation in the line of the chemical effect of cooking potatoes has been done by H. Snyder of Minnesota and reported by him in Bulletin 43, United States Department of Agriculture.

Briefly his method was to boil the potato in a known amount of water, drain them; filter the liquid, and make it up to a known volume from which aliquot portions were taken for analysis. Determinations of total solids, ash, albuminoid nitrogen, total nitrogen and starch were made in this liquor. Total solids were determined by evaporation and drying at 100° C. and ash by burning the total solids. Total nitrogen was determined by the Kjeldahl method, and albuminoid nitrogen by the Stutzer method. For starch the liquor was inverted with HCl and precipitated with Fehling's solution.

In these investigations the potatoes were boiled with and without the skins and in distilled water, lime-water, and alkaline water. Some samples were soaked in cold water before they were boiled; some were placed directly in boiling water; and some in cold water which was then brought to a boil.

Skins removed	Loss of dry matter in fresh potatoes.	Albumin nitrogen	Total nitrogen	Starch	Ash	Percentage loss of each constituent: Dry matter	Albumin	Nitrogen	Total nitrogen	Starch	Ash
Soaked av. 4 hr before cooking	1.45	.038	.181	----	.35	6.5	25.0	51.8	------		38.3
Dis. water, cold	.68	.006	.068	.16	.16	3.	4.3	16.9	1.0		17.9
Alkaline water, cold.	.67	.014	.065	.17	.17	2.9	9.0	15.2	1.0		18.5
Lime water, cold	.75	.013	.061	.16	.19	3.3	9.0	15.3	1.0		20.1
Average of 3 tests, starting with cold water						3.3	7.3	15.8	1.0		18.9
Distilled water, hot.	.62	.004	.025	.10	.13	2.8	2.7	7.5	.6		13.6
Alkaline water, hot.	.76	.003	.037	.18	.21	3.3	2.3	9.2	1.1		22.3
Lime water, hot	.96	.006	.031	.22	.17	4.2	4.3	7.8	1.3		18.5
Average of 3 tests starting with hot water.						3.4	3.2	8.2	1.0		18.1
Skins not removed.											
Dis. water cold	.13	Trace	.005		.03	.6	.2	1.1			5.4
Alkaline water cold.	.10	"	.005		.04	.5	.3	1.1			3.8
Lime water, cold	.04	.002	.003		.01	.2	1.3	.8	.1		1.1
Average of 3 tests starting with cold water.						.4	.6	1.0	.1		3.4
Distilled water, hot.	.16	.001	.005		.05	.7	.5	1.6			4.9
Alkaline water, hot.	.10	Trace	.003		.03	.4	.2	.8			2.7
Lime water, hot.	.05	.001	.002	.01	.02	.2	.5	.7	.1		3.3
Average of 3 tests starting with hot water.						.4	.4	1.0	.1		3.3

From Mr. Snyder's discussion of results; it will be seen that the greatest loss occurs when the potatoes are peeled and soaked before boiling. In this case the loss of nitrogenous matter was from 46 to 58% depending in the length of time they were soaked. Of the albuminoids 25% and of the mineral matter38% were extracted by the water in which the potatoes were cooked. When the potatoes are peeled and put into cold water and heated to boiling as soon as possible, the loss is smaller, about 16% of the nitrogenous matter and 19% of the mineral matter. When the potatoes are peeled and put directly into boiling water, the loss in nitrogen is only half that of the last case, but the mineral matter remains the same. The boiling water coagulates the albuminoids on the surface of the potato; and they, filling the outer pores, partially prevent the loss of the inner juices. A large amount of mineral matter is however, dissolved. There seems to be but little difference in total nitrogenous matter, starch and ash whether distilled, alkaline, or lime water is used. The lime-water, however, has the greatest solvent action upon the albuminoids. The albuminoid material in potato being a globulin which is insoluble in water but soluble in saline solutions, distilled water has the least effect on it. It will be seen that when potatoes are unpeeled the loss of matter is very small; 1% or less of each constituent but mineral matter, and only 3% of that. His conclusions are summarized as follows:

(1). In order to obtain the highest food value, potatoes should not be peeled before cooking.

(2). When peeled, the loss is least when placed in hot water and boiled rapidly and then the loss is very considerable.

If potatoes are peeled and soaked in cold water before cooking, the loss of nutrients is very great; being one fourth of all the albuminoid matter. In a bushel of potatoes, the loss would equal a pound of sirloin steak.

Investigations similar to those of Snyder were carried on by A. J. Frisby and A. P. Bryant, and reported in Bulletin 43 United States Department of Agriculture. Four trials were made, (1) with the skins removed, potatoes placed in cold water and heated immediately; (2) skins removed, placed in boiling water; (3) skins on, placed in cold water and heated up to a high temperature immediately; (4) skins on, placed in boiling water. One litre of water was used for each test; the potatoes boiled until done completely; then the water poured off and the potatoes rinsed off. It was found that in all but the second case the potatoes increased slightly in in weight during cooking.

The liquor was made up to a definite volume, and an aliquot portion was taken for analysis. The cooked potato was also analysed, and the sum of the per cents in the liquor and the cooked sample equaled approximately that in the raw potato. Carbohydrates were estimated by subtracting the sum of the protein and the mineral matter from the total solids. The protein factor used was 5:5.

Loss of Nutrients in Cooking Potatoes.

Skins Removed.	Dry Matter	Album N.	Non-album N.	Total N.	Carbohydrates.	Ash.
Water cold.	3.7%	4.3%	12.9%	8.3%	2.5%	17.0%
Water hot.	4.0%	3.3%	17.9%	10.0%	2.8%	17.4%
Average.	3.9%	3.8%	15.4%	9.2%	2.7%	17.2%

Skins on.	Dry Matter	Album N.	Non-album N.	Total N.	Carbohydrates.	Ash.
Water cold.	.3%	.6%	.6%	.6%	.2%	1.7%
Water hot.	.3%	.4%	1.7%	1.0%	.1%	1.8%
Average.	.3%	.5%	1.1%	.8%	.2%	1.6%

The loss of matter during the process of cooking was confined quite largely to the nitrogen and the ash. It will be noticed that the calculations show loss of carbohydrates and that it was almost nothing when the potatoes were not peeled. When peeled the softened and broken cell walls permit the abrasion of starch particles. There may be a slight loss of starch chemically.

The conclusions are:that boiled, peeled potatoes lose a considerable amount of organic matter and also of mineral matter. The minerals are not exactly nutrients but are important in nutrition. Peeled potatoes lose 3% of the starch and 4% of the nitrogenous matter. Unpeeled potatoes lose almost nothing.

The chief object of the following investigations was to find the losses occuring in the boiling of potatoes in distilled water; and in the baking under varying conditions of temperature and time. In connection with this a complete analyses of whole potatoes, peeled potatoes and peelings were made; as well as determinations of the fixed and volatile acids contained in the cold water extract from potatoes.

A bushel of Early Rose potatoes was washed carefully free from dirt. In selecting samples, care was taken to get as far as possible representatives in size and appearance of the whole lot. A sample of about two kilograms was selected; sliced up into small pieces, and dried in a drying oven until quite brittle; the slices were quickly ground in a sausage-mill and then in a drug-mill until fine enough to pass through a one millimeter sieve. The sample was weighed and kept in a Mason jar. Loss in weight represents water. The other samples of two kilograms each were selected, peeled carefully and preserved just as the first samples. When the samples of Early Rose potatoes were used up samples of Burbank potatoes were bought. Samples for analysis were selected and treated just as described above for the Early Rose. For the tests on baked potatoes, one kilogram samples were taken and baked in an aluminium oven. The first three samples were heated at 180° to 185° C. for forty-five to seventy-five minutes. In all cases until the potatoes were thoroughly done. The temperatures used above being rather high for an ordinary oven and the results of the analysis not being sufficiently accordant another set of tests was made. These were made on Burbank potatoes, since the Early Rose could not be obtained. The temperat-

ures used this time were 125° and 150°, and times two hours and 1/2 and two hours respectively.

Preparation of Sample. The potato whether raw, cooked, or in the form of peelings was sliced fine and placed in iron pans in a drying oven at a temperature of 60° to 70°C. for a period of about thirty hours. The slices were then hard and brittle. The sample was cooled and weighed; the difference between this and the original weight being water. It was then ground, first in a sausage mill and finally in a drug-mill until fine enough to pass through a one m.m. sieve when it was placed in a tight Mason jar to be kept for analysis.

Determination of Water. About two grams of the air-dried sample prepared as above were weighed into an extraction tube with a filter paper bottom. A telescope was used for the weighing to prevent gains or loss during the operation. These tubes were kept in a glycerine oven at 105° c. for eight hours with a current of hydrogen passing through. They were then removed from the oven, cooled and weighed. The loss in weight represented the total amount of water contained in the air dried sample.

Determination of Fat. The tubes containing the water-free sample from the above determination were placed in a Soxhlet ether-extraction apparatus and extracted for twelve hours with absolute ether. The ether was distilled off from the flask which was then dried for an hour in a glycerine oven, cooled and weighed. The increase of this weight over the original weight of the flask gave the weight of extracted fat.

Determination of Ash. A sample of about one and a half grams of

the air-dried substance was weighed out into a crucible and placed in a muffle furnace and heated until the ash was white. It was then cooled and weighed.

Determination of Starch. About three grams of the air-dried substance were weighed out into a Kjeldahl flask, 100c.c. of water added, 20 C.C. of HCl of 1.125 specific gravity, and the mixture boiled two and one half hours with a reflux condenser. The liquid was cooled, and made up to 500c.c. and the solid matter filtered out. Aliquot portions of this filtered liquid were used to precipitate Fehling solution. The Fehling solution is made up according to Allihn modification. 35.629 gr. of $CuSO_4$ are dissolved in 500c.c. of water and 173 gr. of Rochelle salts and 125 gr. KOH in 500.c.c. of water. For each determination, 30 c.c. of each solution was taken and diluted with 60c.c. of water. The mixture was brought to a boil and 25 c.c. of the starch solution added. The reddish precipitate appeared at once. The mixture was boiled three minutes, filtered hot, washed with hot water, burned and weighed as CuO. This is calculated to Cu. and the corresponding weight of dextrose found from Allihn's tables. The weight of dextrose multiplied by nine-tenths gives the weight of the starch.

Determination of Total Nitrogen. About two grams of the air-dried substance are weighed into a Kjeldahl flask, and .065 gr. of Hg. and 25 c.c. of Con. Sulphuric acid added. The mixture was heated in a digester until perfectly colorless, and a little potassium permanganate($K_2Mn_2O_8$) added. It was then cooled, 200 c.c. of water added, 25 c.c. of H_2S; and after shaking thoroughly, a little granulated zinc to prevent bumping in the subsequent distillation.

About 80c.c. of alkali solution (500 gr. of Greenbank alkali to litre of water) was added without mixing. The flask was connected with kjeldahl condensor, shaken until the gas ceases to come over, and then 150 c.c. distilled over into 10 c.c. of standard HCl. The excess of HCl was titrated back with the standard NH_4OH using a corked flask with a capillary tube to prevent the escape of ammonia. Lacinoid was used as indicator. From the amount of NH_4OH required to neutralize the acid, the amount of nitrogen from the sample can be easily calculated.

Determination of Albuminoid Nitrogen. The method used for the air-dried potatoes was Stutzer method. About two grams were weighed into a Kjeldahl flask, 100c.c. of water added, and the mixture heated on a boiling water bath for ten minutes. Then 6 c.c. of a copper hydroxide solution was added, and the whole shaken very thoroughly. By this means the proteid nitrogen is precipitated. The solution was left to stand over night and the next day the solids were filtered out retaining as much as possible in the flask. The solid matter was thoroughly washed, and then the filter paper put into the flask and nitrogen determined just as described for total nitrogen. The copper hydroxide mentioned above was made by dissolving 100 grams of Copper sulphate in five litres of water containing 25 c.c. og glycerine. This was precipitated by a dilute solution of NaOH added until solution was slightly alkaline. The copper hydroxide was filtered out with a Buckner filter keeping from the light as much as possible; and washed with water containing 5% of glycerine; This then rubbed up in a mortar with water containing 10% of glycerine. Enough water was added to make a uniform gelatinous mass which may be measured out with a pipette.

For the protein determination the per cent of albuminoid nitrogen is multiplied by the factor 6.25 which is supposed to represent the ratio between the nitrogen and the total protein.

For the amido nitrogen the albuminoid nitrogen is subtracted from the total nitrogen which gives the per cent of nitrogen as amides.

Analysis of Potatoes.

Whole Early Rose Potatoes.

Calculated to % in fresh sample.

% of water	% Prot-	% of Ash	% Starch	% of Fat	% of Alb. N.	% of Am.N.	% of Tot. N.
79.01	1.64	1.11	16.93	.08	.26	.18	.44
79.67	1.29	1.07	16.92	.07	.21	.25	.46

Peeled Early Rose Potatoes.

78.68	1.44	1.13	17.40	.04	.23	.21	.45
80.02	1.39	1.02	16.43	.16	.23	.12	.35

Potatoes baked 1 hr. at 180° C.

74.45	1.80	1.04	21.14	.10	.29	.19	.48

Potatoes were baked 11/2 hrs. at 180° c.

70.60	1.42	1.25	23.68	.10	.25	.30	.55

Potatoes baked 1 hr. at 185°C.

73.26	1.60	1.00	20.47	.11	.25	.25	.50

Peeled potatoes boiled 1/2 hour.

80.30	.86	.99	16.56	.08	.14	.13	.27

Peelings from above Samples.

80.54	1.17	1.31	11.91	.27	.19	.34	.53

Whole Burbank Potatoes.

79.38	1.40	.79	16.17	.10	.25	.19	.44

Burbank Potatoes baked 2 1/2 hrs. at 125°C.

70.39	1.56	1.20	23.59	.07	.25	.26	.51
69.15	1.56	.93	24.29	.06	.25	.33	.58

Analysis of Potatoes.

Calculated to % in fresh sample.

Burbank Potatoes baked 2 hrs. at 150°C.

% of water	% Prot.	% of Ash	% starch	% of fat	% of Alb. N.	% of Am. N.	% of Tot. N.
73.24	1.59	.93	23.89	.09	.25	.28	.53
71.26	1.54	.92	23.39	.08	.24	.26	.50

Analysis of Potatoes.

Calculated to water-free substance.

Whole Early Rose Potatoes.

% of Prot.	% of ash.	% starch.	% of fat.	% of Album. N.	% of Amido N.	% of Tot. N.
7.79	5.227	80.39	.36	1.23	.87	2.10
6.34	5.27	83.12	.33	1.02	1.26	2.28

Peeled Early Rose Potatoes.

5.72	5.28	81.60	1.18	1.09	.95	2.04
7.03	5.10	82.23	.69	1.13	.64	1.77

Potatoes baked 1 hr. at 180° C.

7.07	4.09	83.07	.39	1.13	.71	1.84

Potatoes baked at 185° C. for 1 hr.

5.16	4.28	80.56	.34	.83	1.02	1.85

Potatoes baked 1 1/2 hrs. at 180° C.

5.73	3.76	73.81	.41	.92	.92	1.84

Peeled potatoes boiled 1/2 hr.

4.36	4.99	84.29	.35	.70	.67	1.37

Peelings from above samples.

6.02	6.74	61.22	1.21	.96	1.79	2.75

Whole Burbank Potatoes.

6.76	3.86	78.42	.55	1.20	.89	2.09

Burbank Potatoes baked 2 1/2 hrs. at 125° C.

5.24	4.05	79.41	.27	.84	.88	1.72
5.04	2.98	78.72	.23	.81	1.04	1.75

Burbank potatoes baked 2 hrs. at 150° C.

5.35	3.20	81.32	.30	.86	.89	1.75
5.93	3.46	83.22	.35	.95	1.02	1.97

An inspection of the above tables shows no considerable difference between the peeled and unpeeled potatoes. The water free substance of the baked Early Rose potato is not changed from the raw more than errors of analysis, at least. In the experiments on Burbank potatoes the baked potato seems to lose a little protein and fat but this apparent change may be due only to errors in analysis. The whole baked potato of course loses from five to twelve per cent of water. The peeled potatoes that were previously boiled show a loss in protein and ash, which has been extracted by the boiling. The raw peelings from the boiled potatoes show a considerable increase in ash and fat and a large decrease in starch.

For the experiments on boiling potatoes, samples of about two kilograms of carefully cleaned Early Rose potatoes were weighed out.

These samples were placed in a granite ware kettle containing 2050 c.c. of water. Two methods were used in the boiling. Part of the samples were placed in water which was already boiling and part in cold water which was immediately heated to boiling. All the samples were boiled for thirty minutes. This was found to complete the cooking in all cases.

When the cooking was completed the water was drained off carefully and the potatoes washed with a little water which is added to the main bulk of the liquid. The whole liquid is filtered through a Buckner funnel under pressure. The liquid was then made up to two litres and aliquot portions taken for analyses. The cooked potatoes were cooled and weighed. It was then sliced, dried and preserved just as the samples of raw potato. Some samples were only 1 kilogram and for them 100c.c. of water were used. After experiments were completed the effects of boiling upon peeled potatoes was investigated. For this samples of about one kilogram each were taken and peeled carefully. The weight of peelings as well as the weight of the potatoes before and after peeling was taken. The peelings were dried and preserved just as the whole potatoes. The rest of the procedure was exactly the same as for the whole potatoes.
As previously stated the potatoes were tested both peeled and unpeeled; some being placed in cold water and heated immediately to boiling, and some placed directly in boiling water.

The liquor from the boiled potatoes was made up to two litres in the first experiments but afterwards to 2100c.c. in order that

larger portions might be taken so that the per cent of error would be lessened.

The determinations made on the liquor were total solids, ash, total nitrogen, albuminoid, and nitrogen and protein, and amides by calculation from the nitrogen. In the latter samples determinations were made of reducing substances before inversion and also after inversion; the difference in the two representing starch. When two litres were used, 250 c.c. were used for total solids and ash and 100 c.c. for the other determinations. When 2100 c.c. were used, 200 c.c. were used for each determination.

Preparation of Solution for Analysis. The liquor was carefully drained off from the potatoes which were washed with a li tle water. The whole amount of liquor and washings were strained through a perforated porcelain plate if any large particles were contained. This strained liquor was filtered through a Buckner filter under pressure. The filter paper was washed, and the liquor was made up to 2100 c.c.

Determination of Total Solids. An aliquot portion of 200 c.c. of the liquor was taken, and evaporated to dryness in a previously weighed platinum dish on a water bath. When dry, placed in a water oven at 100 c.c., and dried to constant weight.

Dete mination of Ash. The total solids, after being weighed were ignited in the dish until whits; and then weighed. The residue is ash dissolved from the potato.

Determination of reducing Substances. Measured out 200 c.c. of the liquor, and added it to Fehling solution made up as for starch without the last dilution with 60 c.c. of water. The mixture was

boiled three minutes, filtered, and burned, and weighed as CuO. This was calculated to Cu.

Determination of Starch. Inverted 200c.c. of the liquor by boiling two and one half hours with a reflux condenser using 10 c.c. of conc. HCl for inverting agent. This was used to precipitate Fehling solution. The precipitate was filtered out and burned and weighed as CuO. This is calculated to Cu. and this by reference to Allihn tables gives dextros which multiplied by nine tenths gives starch.

Determination of Total Nitrogen. Measure out 200 c.c. into a Kjeldahl flask; added Hg and H_2SO_4, and proceeded just as in the Kjeldahl determination for nitrogen in potatoes which has already been described.

Determination of Albuminoid Nitrogen. Measured 200 c.c. into a Kjeldahl flask; acidified with one or two drops of conc. HCl, and added about one half cubic centimeter of Br. Shake vigorously; if the Br. was dissolved add more until there was a little left in the bottom of the flask. By this treatment the proteids are precipitated. The flask was left several hours and the liquid decanted upon a filter paper; washed the precipitate and filter paper with Br. water. Then transferred the filter paper to the flask, and determined nitrogen by the Kjeldahl process. The nitrogen obtained represents that existing in the form of proteids. Protein was calculated from it by multiplying by the factor 6.25. The amid nitrogen was calculated as previously described by subtracting albuminoid from total nitrogen. ~~and multiplying the factor 3.18.~~

Losses in Boiling Early Rose Potatoes.

Placed in boiling water and boiled 1/2 hour.

Calculated to % in fresh sample.

% of Total Solids	% of ash	% of Total Nitrogen	% of Album Nitrogen	% of Amido-Nitrogen	% of Protein	% of Starch
.152	.047	.01 3	.0073	.0052	.045	
.062	.030	.0092	.0054	.0036	.033	
.046	.017	.0070	. 065	.0008	.039	
.041	.011	.0020	.0004	.0016	.003	
.059	.014	.0023	.00057	.0017	.003	.018
			Mean.			
.078	.022	.0066	.0041	.0026	.025	.018
			Mean of the last two Analyses.			
.05	.013	.022	.00053	.0017	.0033	.018
			Potatoes placed in cold water and boiled 1/2 hr.			
.045	.035	.0116	.0062	.0051	.039	
.049	.024	.0090	.0066	.0021	.043	
.049	.0106	.00611	.0054	.0006	.033	
.038	.013	.0018	.00059	.0012	.0038	.020
.039	.009	.0020	.00053	.0015	.003	.014
			Mean.			
.044	.018	.0061	.0039	.0021	.024	.017
			Mean of the last two analyses.			
.039	.0 1	.0019	.00056	.0014	.0034	.017

Losses in Boiling Early Rose Potatoes.

Calculated to % in fresh sample.

Placed in boiling water and boiled 1/2 hour.

% of Total Solids	% of ash.	% of Total Nitrogen	% of Album Nitrogen	% of Amido Nitrogen	% of Protein.	% of Starch.
.785	.18	.034	.00177	.029	.011	.18
.909	.195	.043	.00205	.034	.013	.18

Mean.

.847	.187	.039	.00191	.032	.012	.18

Placed in cold water and boiled 1/2 hour.

.792	.172	.038	.00170	.035	.010	.16
.785	.187	.034	.00177	.029	.012	.19

Mean.

.789	.180	.036	.00174	.032	.011	.18

In the unpeeled potatoes in first three cases the loss of protein in much higher than in the last two, higher in fact than the loss in the peeled potatoes. This cannot be explained except on the ground of errors in analysis which are more probable in view of the fact that they were done first while I was less familiar with the method. The last two samples in each case show a more reasonable loss. These were done after the method had become more familiar to me.

The analyses show no essential difference between placing the potato directly in boiling water or in cold water which is heated to boiling.

The loss in neither case is of much importance from a practical stand point. In the tests in peeled potatoes the losses are, as would be expected, much larger than when the potatoes were unpeeled. The loss in ash is natural by quite considerable but the most important loss from a practical stand point is that of nitrogenous matter which is the most costly food constituent. This loss falls more on the amido-nitrogen than the albuminoid nitrogen. This is evidently the best method of boiling potatoes with the skins on. The loss figured upon a few grams or even pounds of potatoes seems very slight, but when we remember that the production of the United States is annually over 100,000,000 bushels, it can be seen that a very small percentage of loss acquires vast proportions.

INDEX OF SAMPLES.

1 A. Early Rose potatoes, sliced and dried.

1 B. Early Rose potatoes, sliced and dried.

2 A. Early Rose potatoes, peled, sliced and dried.

2 B. Early Rose potatoes, peeled, sliced and dried.

3 A. Potatoes placed in boiling water and boiled 1/2 hour. Both potatoes and liquor.

3 B. Potatoes placed in boiling water and boiled 1/2 hour. Both potatoes and liquor.

4 A. Potatoes placed in cold water and boiled 1 hour. Both potatoes and liquor.

4 B. Potatoes placed in cold water and boiled 1/2 hour. Both potatoes and liquor.

5. Potatoes baked 1 hour at 180°C.

6. Potatoes baked 1 1/2 hours at 185°C.

7. Potatoes baked 1 hour at 180°C.

8. Potatoes put in cold water. Boiled 1/2 hour

9. Liquor from sample 8.

10. Potatoes put in boiling water. Boiled 1/2 hour.

11. Liquor from sample 10.

12. Potatoes put in boiling water. Boiled 1/2 hour.

13. Liquor from sample 12.

14. Potatoes put in cold water. Boiled 1/2 hour.

15. Liquor from sample 14.

16. Potatoes put in boili g water. Boiled 1/2 hour.

17. Liquor from sample 16.

18. Potatoes put in cold water. Boiled 1/2 hour.

19. Liquor from sample 18.

20. Peeled potatoes put in boiling water. Boiled 1/2 hour.

21. Peelings from sample 20.

22. Liquor from sample 20.

23. Peeled potatoes put in cold water. Boiled 1/2 hour.

24. Peelings from sample 23.

25. Liquor from sample 25.

26. Peeled potatoes put in cold water. Boiled 1/2 hour.

27. Peelings from sample 26.

28. Liquor from sample 26.

29. Peeled potatoes put in boiling water. Boiled 1/2 hour.

30. Peelings from sample 29.

31. Liquor from sample 29.

32. Peeled potatoes put in boiling water. Boiled 1/2 hour.

33. Peelings from sample 32.

34. Liquor from sample 32.

36. Burbank potatoes baked at 125°C. for 2 1/2 hours.

37. Burbank potatoes baked at 125°C. for 2 1/2 hours.

38. Burbank potatoes baked at 150°C. for 2 hours.

39. Burbank potatoes baked at 150°C. for 2 hours.

40. Burbank potatoes sliced and dried.

Water

lost in preparing air-dried sample.

Sample NO.	Weight fresh sample	Wt. dried sample	Loss in Weight.	% of Water	S. No	Weight fresh sample	Weight dried sample	Loss in weight	% of water
1 A.	2070.8	458.94	1611.86	77.83	20	983.13	212.40	770.70	78.38
1 B.	1997.0	425.40	1571.69	78.70	21	145.10	30.76	114.34	78.80
2 A.	1709.0	383.83	1325.26	77.54	23	960.1	220.30	739.80	77.06
2 B.	1806.2	390.82	1415.39	78.36	24	159.15	35.36	123.79	78.90
3 A.	2024.3	486.58	1537.74	75.96	26	863.80	208.14	655.66	75.91
3 B.	1969.1	427.79	1541.35	78.22	27	140.65	27.87	112.78	82.06
4 A.	1925.5	449.28	1476.23	76.67	29	866.62	224.10	642.10	74.09
4 B.	1933.2	462.30	1470.97	76.03	30	135.83	28.85	106.980	78.77
5.	972.73	243.50	723.23	73.26	32	822.7	220.89	601.81	73.15
6.	689.30	215.30	474.00	68.77	33	178.15	42.94	135.21	75.90
7.	838.85	253.85	585.00	69.74					
8.	1970.3	464.77	1505.53	76.40	36	794.71	258.74	535.97	67.45
10.	1661.5	462.30	1199.20	72.19	37	809.72	276.35	533.37	65.87
12.	1058.5	273.99	784.51	74.12	38	803.65	255.28	548.37	68.24
14.	1009.9	263.13	746.77	73.94	39	852.86	258.84	594.02	69.65
16.	1040.6	265.71	774.89	74.47	40	589.16	138.30	451.86	76.68
18.	1023.5	280.68	742.82	72.58					

Water and Fat

in air-dried substance of potato.

Sample No.	Telescope + tube.	Telescope +tube + sample	Weight of Sample.	Teles. + tube + sam after 8 hrs.	Loss in Wt.	% of water.
1 A.	50.7778	54.3305	3.5527	54.1470	.1835	5.17
	51.1942	53.7762	2.5820	53.6407	.1355	5.25
	51.7297	54.0912	2.3615	53.9620	.1292	5.47
	51.8699	54.7013	2.8314	54.5508	.1509	5.33
1 B.	51.3855	53.6720	2.2865	53.5716	.1004	4.39
	51. 942	53.8104	2.1162	53.7185	.0919	4.49
	52.4669	54.7816	2.2147	54.6779	.1037	4.68
	51.2319	53.4548	2.2229	53.3513	.1035	4.65
2 A.	50.6158	52.8570	2.2412	52.7246	.1324	5.91
	50.1873	52.4837	2.2964	52.3375	.1462	6.35
	51.6838	53.9505	2.2667	53.8135	.1370	6.04
	51.5452	54.1370	2.5818	53.9830	.1540	5.96
2 B.	51.5330	53.6572	2.1242	53.4940	.1632	7.68
	51.4279	53.8048	2.3769	53.6242	.1806	7.60
	50.7542	52.7501	1.9959	52.5974	.1527	7.65
	50.6202	52.8162	2.1960	52.6466	.1696	7.72

Continued on next page.

Water and Fat

in air-dried substance of poatto.

Sample No.	Weight of Flask	Flask + Fat.	Weight of fat.	% of fat.
1 A.	34.9952	35.0065	.0113	.32
	38.4533	38.4623	.009	.35
	29.9625	29.9772	.0147	.62
	40.6100	40.6172	.0072	.26
1 B.	33.4125	33.4224	.0099	.43
	28.0062			
	37.9332	37.9589	.0157	.26
	33.5990			
2 A.	37.8105	37.8142	.0042	.19
	33.7481	33.7522	.0041	.18
	35.3075	35.3115	.004	.19
	35.0921	35.0975	.0054	.21
2 B.	29.9625			
	35.6098	35.6249	.0151	.63
	35.1710	35.1894	.0184	.92
	37.8105	37.8258	.0153	.69

Water and Fat.

in air-dried substance of potato.

Sample No.	Teles. + tube.	Teles. + tube + sample.	Wt. of sample	Teles + tube+sam. after 8hr	Loss in weight	% of water.
5.	51.9629	53.9986	2.0357	53.9023	.0963	4.73
	53.1644	55.5858	2.4214	55.4741	.1117	4.61
6.	50.7378	53.2857	2.5479	53.1371	.1486	5.83
	52.2190	54.7082	2.4892	54.5602	.1480	5.95
7.	50.6612	52.9211	2.2599	52.7317	.1894	8.27
	50.8048	57.0497	2.2449	52.8620	.1877	8.36
20.	50.9468	52.6831	1.7363	52.5291	.1540	8.87
	50.8462	52.9711	2.1249	52.7831	.1880	8.84
21.	52.2822	54.8664	2.5842	54.6534	.2130	8.24
	50.2700	52.2761	2.0061	52.1130	.1631	8.13
36.	50.9468	52.6902	1.7434	52.5305	.1597	9.16
	50.8506	52.6666	1.8160	52.5047	.1619	8.92
37.	50.2297	51.9396	1.7099	51.7771	.1625	9.56
	52.5106	54.7838	2.2732	54.5646	.2192	9.64
38.	51.1711	53.4290	2.2489	52.2157	.2133	9.49
	51.2962	52.9619	1.6657	52.8041	.1578	9.53

Water and Fat

in air-dried substance of potato.

Sample No.	Wt. of Flask.	Flask + fat.	Wt. of fat.	% of fat.
5.	27.4924	27.5004	.008	.39
	37.0495	37.058	.0085	.35
6.	31.2191	31.2279	.0088	.35
	38.7276	38.7350	.0074	.29
7.	32.9113	32.9198	.0085	.37
	32.1118	32.1205	.0087	.38
20.	36.008	36.0135	.0055	.32
21.	31.7636	31.7944	.0288	.112
	42.5533	42.5755	.0222	.111
36.	47.3140	47.3179	.0039	.22
	42.6314	42.6363	.0049	.27
37.	32.9853	32.9886	.0033	.19
	37.0187	37.0234	.0047	.20
38.	32.8402	32.8464	.0062	.27
	37.4348	37.4390	.0042	.25

Water and Fat

in air-dried substance of potato.

Sample No.	Telescope + Tube	Teles. + tube + sample	Weight of Sample	Teles. + tube + sam. After 8 hr.	Loss in weight.	% of water.
39.	50.2757	51.9924	1.7167	51.7908	.2016	11.74
	49.7084	51.3865	1.6781	51.1861	.2004	11.94
40.	49.9411	51.4254	1.4843	51.2492	.1762	11.87
	50.8755	52.1176	1.2421	51.9687	.1489	11.99

The following results continued from above samples.

Sample No.	Weight of flask.	Flask + fat.	Weight of fat.	% of fat.
39.	37.9102	37.9147	.0045	.036
	38.7238	38.7302	.0064	.037
40.	27.4005	27.4080	.0075	.051

Ash

in air-dried substance of potato.

Sample No.	Sample + crucible	Weight of crucible	Weight of sample	Crucible + ash.	Weight of ash.	% of ash.
1 A.	8.4450	6.3270	2.1180	6.4346	.1076	5.08
	10.9088	8.8519	2.0569	8.9581	.1072	5.16
	8.1095	6.1312	2.0783	6.2308	.0996	4.79
	9.8928	8.1570	1.7358	8.2428	.0858	4.94
1 B.	9.5779	7.6606	1.9073	7.7572	.0966	5.06
	9.7290	8.3491	1.3799	8.4194	.0703	5.02
	9.8423	8.0430	1.7992	8.1332	.0902	5.01
	8.9228	7.2298	1.6930	Lost	Lost	Lost
2 A.	10.0267	8.3141	1.7126	8.4001	.0860	5.02
	9.4842	7.6622	1.8220	7.7540	.0918	5.03
	9.7239	7.8483	1.8756	7.9416	.0932	4.97
	7.9149	6.0325	1.9824	6.1285	.0960	4.90
2 B.	7.3870	5.6152	1.7718	5.6975	.0823	4.65
	7.9482	6.0650	1.8832	6.1546	.0896	4.76
	10.7120	9.0420	1.6700	9.1197	.0777	4.65
	8.1500	6.1308	2.0192	6.2276	.0968	4.79

Ash

in air-dried substance of potato.

Sample No.	Crucible + sample	Weight of crucible	Weight of sample	Crucible + Ash.	Weight of Ash	% of Ash.
3 A.	6.9781	5.6150	1.3631	5.6803	.0653	4.80
	9.8413	7.8471	1.9942	7.9415	.0944	4.70
	11.0279	9.0410	1.9869	9.1341	.0931	4.69
	8.9706	7.1127	1.8578	7.1991	.0864	4.65
3 B.	10.0002	8.3170	1.683	8.3972	.0802	4.76
	7.8738	6.0645	1.8092	6.1530	.0885	4.88
	7.7837	6.0315	1.7522	6.1174	.0819	4.67
	7.8262	5.9345	1.8917	6.0264	.0919	4.85
5.	7.8441	6.1816	1.6625	6.2447	.0631	3.79
	8.4255	6.4679	1.9576	6.5474	.0795	4.06
6.	9.4893	7.6892	1.8001	7.7608	.0716	3.98
	9.2050	7.4820	1.7230	7.5506	.0868	3.97
7.	7.7360	6.1284	1.6076	6.1816	.0532	3.30
	9.3891	7.8610	1.5281	7.9101	.0491	3.22
20.	6.4455	7.9713	1.5258	6.3170	.0715	4.60
	8.3051	9.7993	1.4942	8.3735	.0684	4.57

Ash

in air dried substance of potato.

Sample No.	Wt. of crucible	Wt. of crucible + sample	Wt. of sample	Crucible + ash.	Wt. of Ash.	% of Ash.
21.	6.5923	7.7672	1.1749	6.6654.	.0731	6.22
	6.4646	7.4811	1.0165	6.5272	.0626	6.16
36.	9.0175	10.3667	1.3492	9.0679	.0504	3.73
	7.1106	8.5160	1.4054	7.1613	.0507	3.61
37.	7.4307	9.2640	1.8333	7.4809	.0502	2.74
	8.0840	9.8612	1.7772	8.1312	.0472	2.66
38.	8.0381	10.4134	2.3753	8.1066	.0687	2.88
	8.3510	9.9175	1.5665	8.3966	.0456	2.91
39.	7.7051	9.1179	1.4128	7.7477	.0426	3.01
	7.4028	9.0370	1.6342	7.4534	.0506	3.09
40.	6.4450	8.1864	1.7414	6.5040	.0590	3.39
	6.5919	7.7092	1.1173	6.6299	.0380	3.40

Total Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of sample	Acid Used	NH_3 sol required	NH_3 sol equiv. to N	Acid factor	N. factor	Wt. of N.	% of N.
1 A.	3.6038	15c.c.	9.00c.c.	21.37 1/2	.493	.00472+	.04985	1.91
	1.8363	10c.c.	4.20c.c.	16.05	.493	"	.03743	2.03
	2.0911	10 "	2.60c.c.	17.65	.493	"	.04117	1.97
	1.8504	10 "	4.15c.c.	16.10	.493	"	.03755	2.03
1 B.	1.7391	10 "	4.10c.c.	16.15	.493	"	.03767	2.16
	1.8722	10 "	2.80c.c.	17.45	.493	"	.04070	2.17
	1.7560	10c"	3.70	16.55	.493	"	.03860	2.19
	1.5823	10 "	5.00c.c.	15.25	.493	"	.03522	2.22
2 A.	1.1597	10 "	10.50	9.75	.493	"	.02274	1.96
	1.4005	10 "	8.90	11.35	.493	"	.02647	1.89
	1.3080	10 "	9.55c.c.	10.70	.493	"	.02496	1.91
	1.4934	10 "	8.15	12.10	.493	"	.02822	1.89
2 B.	1.3460	10 "	10.55	9.70	.493	"	.02262	1.68
	1.6396	10 "	9.05	11.20	.493	"	.02612	1.59
	1.5362	10 "	9.60	10.65	.493	"	.02484	1.62
	1.4818	10 "	10.20	10.20	.493	"	.02379	1.61

Total Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of sample	Acid Used	NH_3 sol. required	NH_3 sol. equiv. to N.	Acid factor	N. factor	Wt. of N.	% of N.
3 A.	2.5416	15 c.c.	11.65	18.621/2	.493	.0047248	.04377	1.80
	1.7045	10c.c.	6.80	13.45	.493	.0047248	.03137	1.84
	2.1970	10c.c.	3.55	16.70	.493	.0047248	.03895	1.77
	1.8722	10c.c.	5.65	14.60	.493	.0047248	.03404	1.81
3 B.	1.5229	10c.c.	7.70	12.55	.493	.0047248	.02927	1.92
	1.8746	10c.c.	5.25	15.00	.493	.0047248	.03498	1.86
	2.2299	10c.c.	2.80	17.45	.493	.0047248	.04070	1.82
	1.5748	10c.c.	7.50	12.75	.493	.0047248	.02974	1.8
5.	2.3475	10c.c.	2.90	20.65	.425	.0047376	.0414	1.76
	1.5508	10c.c.	10.20	13.35	.425	.0047376	.0268	1.73
6.	1.6435	10c.c.	9.40	14.15	.425	.0047376	.0284	1.73
	1.7693	10c.c.	8.00	15.65	.425	.0047376	.0314	1.75
7.	1.6376	10c.c.	9.70	13.85	.425	10047376	.0278	1.70
	1.4149	10c.c.	11.90	11.65	.425	.0047376	.0234	1.66
20.	2.2386	10c.c.	9.45	14.10	.425	10047376	.0283	1.26
	1.3059	10c.c.	15.55	8.00	.425	.0047376	.0161	1.23

Total Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of sample	Acid Used	NH_3 sol. required	NH_3 sol equiv. to N.	Acid factor	N. factor.	Wt. of N.	% of N.
21.	1.3195	10c.c.	7.20	16.35	.425	.0047376	.0328	2.49
	1.4483	10c.c.	5.20	18.35	.425	.0047376	.0368	2.55
36.	2.0678	10c.c.	7.65	15.90	.425	.0047376	.0319	1.54
	1.4322	10c.c.	12.20	11.35	.425	.0047376	.0227	1.58
37.	1.8926	10c.c.	8.80	16.75	.425	.0047376	.0336	1.78
	1.3774	10c.c.	12.40	11.15	.425	.0047376	.0223	1.62
38.	1.7606	10c.c.	9.30	14.25	.425	.0047376	.0286	1.62
	1.8580	7.5	3.35	14.30	.425	.0047376	.0287	1.54
39.	1.6323	10c.c.	9.10	14.45	.425	.0047376	.0290	1.77
	1.6021	10c.c.	9.95	13.60	.425	.0047376	.0273	1.70
40.	1.8435	10c.c.	7.00	16.55	.425	.0047376	.0332	1.80
	1.3420	10c.c.	10.95	12.60	.425	.0047376	.0253	1.88

Albuminoid Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of Sample	Acid Used	NH_3 vol. required	NH_3 vol. equiv. to N.	Acid factor	N. factor.	Wt. of N.	% of N.
1 A.	1.6711	10c.c.	11.45	8.80	.493	.0047248	.02052	1.23
	1.3930	10c.c.	13.70	6.55	.493	.0047248	.01582	1.10
	1.7980	10c.c.	10.80	9.45	.493	.0047248	.02204	1.22
	1.7280	10c.c.	11.55	8.70	.493	.0047248	.02029	1.17
1 B.	2.1071	10c.c.	11.40	8.85	.493	.0047248	.02065	.98
	1.6791	10c.c.	13.40	6.85	.493	.0047248	.01595	.95
	1.9103	10c.c.	11.90	8.30	.493	.0047248	.01929	1.01
	2.0391	10c.c.	12.10	8.15	.493	.0047248	.01901	.93
2 A.	1.8978	10c.c.	13.45	6.80	.493	.0047248	.01586	.99
	2.0470	10c.c.	12.00	8.25	.493	.0047248	.01924	.94
	1.5895	10c.c.	13.15	7.10	.493	.0047248	.01656	1.04
	1.3448	10c.c.	13.85	6.40	.493	.0047248	.01493	1.11
2 B.	1.4009	10c.c.	14.25	6.00	.493	.0047248	.01399	.99
	1.5330	10c.c.	13.10	7.15	.493	.0047248	.01678	1.09
	1.6094	10c.c.	13.10	7.15	.493	.0047248	.01678	1.04
	1.6163	10c.c.	13.05	7.20	.493	.0047248	.01699	1.05

Albuminoid Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of Sample	Acid Used	NH_3 sol. required	NH_3 sol. equiv. to N.	Acid factor	N. factor	Wt. of N.	% of N.
5.	2.1043	10c.c.	12.25	11.30	.425	.004376	.0227	1.08
	1.7937	10c.c.			.425	.004376		
6.	1.8303	10c.c.	16.60	6.95	.425	.0047376	.0139	.76
	1.8218	10c.c.	16.30	7.25	.425	.0047276	.0145	.79
7.	1.7339	10c.c.	16.40	7.15	.425	.0047376	.0143	.82
	1.3968	10c.c.	17.65	6.00	.425	.0047376	.0120	.86
20.	1.4106	10c.c.	19.10	4.45	.425	.0047376	.0089	.63
	1.4335	10c.c.	18.95	4.60	.425	.0047376	.0092	.64
21.	1.1874	10c.c.	15.90	7.65	.425	.0047376	.0153	.88
	1.2017	10c.c.	15.85	7.70	.425	.0047376	.0154	.88
36.	1.8241	10c.c.	16.60	6.95	.425	.0047376	.0139	.76
	1.9435	10c.c.	16.10	7.45	.425	.0047376	.0149	.76
37.	2.0607	10.c.c.	16.35	7.20	.425	.0047376	.0144	.70
	1.4352	10c.c.	18.10	5.45	.425	.0047376	.0109	.76
38.	1.8406	10c.c.	16.45	7.10	.425	.0047376	.0142	.77
	1.7726	10c.c.	16.65	6.90	.425	.0047376	.0138	.78

Albuminoid Nitrogen

in air-dried substance of potato.

Sample No.	Wt. of sample	Acid used.	NH_3 sol. required	NH_3 sol. equivalent	Acid factor	N. factor.	Wt. of N.	% of N.
39.	1.4950	10c.c	17.35	6.20	.425	.0047376	.0124	.83
	1.5305	10c.c	17.15	6.40	.425	" "	.0128	.84
40.	1.2030	10c.c	17.70	5.85	.425	.0047376	.0117	.97
	1.7248	10c.c	15.45	8.10	.425	.0047376	.0162	.84

Protein

in air-dried substance of potato.

Sample No.	Wt. of Sample	Acid Used	NH_3 sol. required	NH_3 sol. equiv. to N.	Acid. factor	Protein factor	Wt. of Prot.	% of Prot
1 A.	1.6711	10c.c.	11.45	8.80	.493	.02953	.1283	7.67
	1.3930	10c.c.	13.70	6.55	.493	.02953	.0955	6.86
	1.7980	10c.c.	10.80	9.45	.493	.02953	.1377	7.65
	1.7280	10c.	11.55	8.70	.493	.02953	.1268	7.34
1 B.	2.1071	10c.c.	11.40	8.85	.493	.02953	.1291	6.12
	1.6791	10c.c.	13.40	6.85	.493	.02953	.0997	5.94
	1.9103	10c.c.	11.90	8.30	.493	.02953	.1206	6.31
	2.0891	10c.c.	12.10	8.15	.493	.02953	.1188	5.82
2 A.	1.5978	10c.c.	13.45	6.80	.493	.02953	.0991	6.20
	2.0470	10c.c:	12.00	8.25	.493	.02953	.1203	5.87
	1.5895	10c.c.	13.15	7.10	.493	.02953	.1035	6.51
	1.3448	10c.c.	13.85	6.40	.493	.02953	.0933	6.94
2 B.	1.4009	10c.c.	14.25	6.00	.493	.02953	.0875	6.20
	1.530	10c.c.	13.10	7.15	.493	.02953	.1048	6.81
	1.6094	10c.c.	13.10	7.15	.493	.02953	.1048	6.50
	1.6163	10c.c.	13.05	7.20	.493	.02953	.1062	6.56

Protein

in air dried substance of potato.

Sample No.	Wt. of sample	Amt. of Acid	NH_3 sol. required	NH_3 sol equiv. to N.	Acid factor	Protein factor	Wt. of Prot.	% of Prot.
5.	2.1043	10c.c.	12.25	11.30	.425	.02961	.1419	6.74
	1.7937	10c.c.			.425	.02961		
6.	1.8303	10c.c.	16.60	6.95	.425	.02961	.0869	4.76
	1.8218	10c.c.	16.30	7.25	.425	.02961	.0906	4.97
7.	1.7339	10c.c.	16.40	7.15	.425	.02961	.0894	5.15
	1.3968	10c.c.	17.65	6.00	.425	.02961	.0750	5.37
20.	1.4106	10c.c.	19.10	4.45	.425	.02961	.0556	3.94
	1.4335	10c.c.	18.95	4.60	.425	.02961.	.0575	4.01
21.	1.1874	10c.c.	15.90	7.65	.425	.02961	.0656	5.53
	1.2015	10c.c.	15.85	7.70	.425	.02961	.0663	5.52
36.	1.8241	10c.c.	16.60	6.95	.425	.02961	.0869	4.75
	1.9425	10c.c.	16.10	7.45	.425	.02961	.0937	4.79
37.	2.0607	10c.c.	16.35	7.20	.425	.02961	.0900	4.38
	1.4352	10c.c.	18.10	5.45	.425	.02961	.0681	4.75
38.	1.8406	10c.c.	16.45	7.10	.425	.02961	.0888	4.81
	1.7726	10c.c.	16.65	6.90	.425	.02961	.0851	4.87

Protein

in air-dried substance of potato.

Sample No.	Wt. of sample	Acid used	NH_3 sol. required	NH_3 sol. equivalent	Acid factor	Protein factor	Wt. of prot.	% of prot.
39.	1.4950	10c.c.	17.35	6.20	.425	.02961	.0763	5.19
	1.5305	10c.c.	17.15	6.40	.425	.02961	.0800	5.25
40.	1.2030	10c.c.	17.70	5.85	.425	.02961	.0731	6.07
	1.7248	10c.c.	15.45	8.10	.425	.02961	.1013	5.83

Amido Nitrogen

in air-dried substance of potato.

Sample No.	Av. % of total N.	Av. % of Album N.	Av. % of N. as amides.
1 A.	1.99	1.18	.81
1 B.	2.19	.97	1.22
2 A.	1.91	1.08	.83
2 B.	1.63	1.13	.50
5.	1.75	1.08	.67
6.	1.74	.78	.96
7.	1.68	.84	.84
20.	1.25	.64	.61
21.	2.52	.88	1.64
36.	1.56	.76	.80
37.	1.70	.73	.97
38.	1.58	.78	.80
39.	1.74	.84	.90
40.	1.84	.96	.88

Starch

in air-dried substance of potato.

Sample No.	Wt. of sample	Vol. of solution	Amt. of sol. used.	Wt. of cruc.	Cruc + CuO	Wt. of CuO	Wt. of Cu.	Total wt. of starch	% of starch.
1 A.	2.9131	500c.c.	25c.c.	8.3140	8.6073	.2933	.2341	2.1878	75.11
			25c.c.	8.8501	9.1527	.3026	.2415	2.2451	77.07
1 B.	2.9958	500c.c.	25c.c.	5.9356	6.2559	.3203	.2556	2.3800	79.44
			25c.c.	6.8163	7.1159	.3196	.2550	2.3745	79.24
			25c.c.	7.0765	7.3966	.3201	.2555	2.3792	79.43
			25c.c.	7.2304	7.5518	.3214	.2565	2.3841	79.71
2 A.	2.8274	500c.c.	25c.c.	6.4541	6.7450	.2909	.2320	2.1568	76.28
			25c.c.	7.2260	7.5189	.2929	.2337	2.1790	77.07
2 B.	2.6609	500c.c.	25c.c.	9.0394	9.3124	.2730	.2178	2.0160	75.76
			25c.c.	7.8405	8.1146	.2741	.2187	2.0250	76.10
5.	2.8416	500c.c.	25c.c.	7.4322	7.7372	.3050	.2434	2.2627	79.65
			25c.c.	8.1181	8.4200	.3019	.2409	2.2395	78.44
6.	2.3686	500c.c.	25c.c.	7.6274	7.8732	.2458	.1961	1.8099	76.41
			25c.c.	7.1220	7.3640	.2420	.1931	1.7811	75.20
7.	2.6842	500c.c.	25c.c.	7.7697	8.0175	.2478	.1977	1.8243	67.98
			25c.c.	6.1854	6.4309	.2455	.1959	1.8081	67.37

Starch

in dried air substance of potato.

Sample No.	Wt. of sample	Amt. of sol. used	Amt. of sol. used.	Wt. of cruc.	Crucible + CuO.	Wt. of CuO.	Wt. of Cu.	Total wt. of starch	% of starch
20.	2.157	500c.c.	25c.c.	6.1685	6.3994	.2309	.1843	1.6983	77.28
			25c.c.	7.2917	7.4493	.2286	.1824	1.6803	76.46
21.	2.3324	500c.c.	25c.c.	5.6098	5.7909	.1811	.1445	1.3257	56.83
			25c.c.	8.1423	8.3198	.1775	.1417	1.2969	55.60
36.	2.5811	500c.c.	25c.c.	7.6259	7.8777	.2524	.2014	1.8603	72.08
			25c.c.	5.7028	5.9562	.2534	.2022	1.8684	72.38
37.	1.7563	500c.c.	25c.c.	7.7056	7.8765	.1709	.1364	1.2510	71.19
			25c.c.	8.0392	8.2107	.1715	.1369	1.2555	71.45
38.	1.8570	500c.c.	25c.c.	7.3603	7.5452	.1849	.1476	1.3547	78.66
			" "	7.4042	7.5895	.1853	.1479	1.3579	73.66
39.	2.7955	500c.c.	25c.c.	6.7422	7.0104	.2682	.2140	1.9800	73.15
			25c.c.	9.2876	9.5567	.2691	.2147	1.9872	73.59
40.	1.8401	500c.c.	25c.c.	6.5869	6.7600	.1731	.1381	1.2663	68.82
			25c.c.	6.6405	6.8148	.1743	.1391	1.2753	69.31

Complete Analysis

of potatoes.

Calculated to fresh substarce.

Sample No.	% of Water	% of Protein	% of Ash	% of Starch	% of Fat	Album Nitrogen	Amido N.	Total N.
1 A.	79.01	1.70	1.13	16.77	.061	.27	.18	.42
		1.52	1.14	17.08	.071	.24		.45
		1.69	1.06		.120	.27		.44
		1.63	1.10		.050	.26		.45
1 B.	79.67	1.30	1.08	16.92	.09	.21	.25	.46
		1.27	1.07	16.88	.05	.20		.46
		1.34	1.07	16.92		.22		.47
		1.24		16.97		.20		.47
2 A.	78.68	1.39	1.14	17.31	.041	.22	.21	.45
		1.32	1.14	17.46	.04	.21		.43
		1.48	1.11		.04	.24		.43
		1.56	1.11		.04	.25		.43
2 B.	80.02	1.34	1.01	16.39	.122	.21	.12	.36
		1.47	1.03	16.47	.170	.24		.34
		1.41	1.01		.131	.23		.35
		1.42	1.04		.23	.23		.36

Complete Analysis

of potatoes.

Calculated to fresh substance.

Sample No.	% of Water	% of Protein.	% of Ash	% of Starch	% of Fat.	% of Albumin Nitrogen	% of Amido N.	% Total N.
5.	74.45	1.80	1.01	21.30	.10	.29	.19	.48
			1.06	20.97	.09			.47
6.	70.61	1.49	1.25	23.86	.11	.24	.30	.54
		1.54	1.25	23.49	.09	.25		.55
7.	73.26	1.56	1.01	20.57	.11	.25	.25	.51
		1.63	.99	20.37	.11	.26		.49
20.	80.30	.85	.99	16.70	.08	.14	.13	.27
		.87	.98	16.42		.14		.26
21.	80.54	1.17	1.32	12.05	.27	.19	.33	.53
		1.17	1.30	11.78	.27	.19		.54
36.	70.39	1.55	1.22	23.54	.06	.25	.26	.50
		1.56	1.18	23.64	.08	.25		.51
37.	69.15	1.49	.93	24.24	.06	.24	.32	.59
		1.62	.90	24.34	.06	.26		.56
38.	71.26	1.53	.91	23.36	.07	.24	.26	.49
		1.55	.92	23.41	.08	.24		.51

Complete Analysis

of potatoes.

Calculated to fresh Substance.

Sample No.	% of Water	% of Protein.	% of Ash.	% of Starch	% of Fat.	Albumin Nitrogen	Amido-N.	Total N.
39.	73.24	1.58	.92	23.82	.07	.25	.28	.52
		1.59	.94	23.96	.11	.25		.54
40.	79.38	1.42	.79	16.11	.10	.25	.19	.42
		1.37	.79	16.22		.24		.44

Complete Analysis of Potatoes.

Calculated to water-free Substance.

Sample No.	Protein: % of	% of Ash.	% of Starch.	% of Fat.	% Album N.	% of Amido Nitrogen	Total Nitrogen.
1 A.	8.09	5.36	79.40	.30	1,30		2.02
	7.24	5.44	81.38	.33	1.16	.87	2.14
	8.07	5.06		.59			2.08
	7.75	5.22		.25	1.23		2.14
1 B.	6.41	5.30	83.22	.41	1.03		2.25
	6.23	5.26	83.02		1.00	1.2	2.26
	6.61	5.25	83.21	.25	1.06		2.28
	6.10		83.49		.97		2.32
2 A.	6.53	5.34	81.18	.18	1.05		2.09
	6.18	5.35	82.02	.17	1.00	.95	2.01
	6.86	5.23		.18	1.11		2.03
	7.31	5.22		.20	1.18		2.01
2 B.	6.71	5.04	82.04		1.07		1.82
	7.38	5.15	82.41	.58	1.18	.64	1.72
	7.04	5.04		.85	1.13		1.75
	7.00	5.18		.64	1.14		1.74

Complete Analysis of substance of potato.

Calculated to water-free substance.

Sample No.	% of Protein	% of Ash.	% of Starch	% of Fat	% of Albumin.	% of Amido-Nitrogen	% Total Nitrogen.
5.	7.07	3.98	83.35	.41	1.13		1.85
		4.20	82.28	.37		.71	1.82
6.	5.06	4.23	81.20	.37	.81		1.84
	5.27	4.32	79.91	.31	.84	1.02	1.86
7.	5.62	3.60	74.14	.40	.90		1.85
	5.84	3.52	73.48	.41	.94	.92	1.81
20.	4.32	5.00	84.79	.35	.69		1.38
	4.40	4.97	83.89		.70	.66	1.35
21.	6.02	6.77	61.80	1.21	.96		2.71
	6.01	6.70	60.55	1.20	.96	1.75	2.78
36.	5.22	4.11	79.24	.24	.84		1.69
	5.26	3.98	79.57	.30	.84	.88	1.74
37.	4.83	3.02	78.57	.22	.77		1.96
	5.24	2.93	78.86	.23	.84	1.06	1.79
38.	5.32	3.18	81.22	.31	.85		1.79
	5.38	3.21	81.41	.28	.86	.90	1.70

Complete Analysis

of air-dried substance of the potato.

Calculated to water-free substance.

Sample No.	% of Protein	% of Ash.	% of Starch	% of Fat.	Albun N. % of	% of Amido-N.	% of Tot-N.
39.	5.89	3.41	82.97	.29	.94		2.01
	5.96	3.50	83.47	.41	.95	1.02	1.93
40.	6.89	3.85	78.14	.55	1.22		2.04
	6.62	3.86	77.69		1.18	.89	2.14

Total Solids

in liquid after cooking potatoes.

Sample No.	Wt. of Sample	Total amount of sol	Amt. of solution used.	Weight of Pt. dish.	Pt. dish + solids	Weight of Solids.	% of Solids.
3 A.	2024.32	2000	250c.c.	45.2074	45.5906	.3832	.152
		2000	250c.c.	40.6645	41.0470	.3825	.151
3 B.	1969.14	2000	250c.c.	44.4306	44.5811	.1505	.0610
		2000	250c.c.	44.6052	44.7951	.1539	.0626
4 A.	1925.51	2000	250c.c.	44.5973	44.7083	.110	.046
		2000	250c.c.	44.4191	44.5249	.1058	.044
4 B.	1933.23	2000	250c.c.	44.5973	44.7154	.1184	.049
		2000	250c.c.	44.5191	44.5363	.1172	.049
9.	1970.3	2000	250c.c.	44.4102	44.5315	.1213	.049
		2000	250c.c.	40.6290	40.7503	.1213	.049
11.	1661.5	2000	250c.c.	44.5930	44.6900	.0970	.047
		2000	250c.c.	44.4102	44.5040	.0938	.0457
13.	1058.5	2000	250c.c.	45.1688	45.2229	.0541	.0411
		2000	250c.c.	44.6844	44.7396	.0552	.0416
15	1009.9	2000	250c.c.	40.6260	40.6751	.0491	.0388
		2000	250c.c.	45.1680	45.2162	.0482	.0381

Total Solids

in liquid after cooking potato.

Sample No.	Wt. of Sample	Total amount of Sol	Amt. sol Used	Weight of Pt. dish	Pt. dish + solids	Weight of Solids.	% of solids
17.	1040.6	2000	250c.c.	44.7852	44.7480	.0628	.0600
		2000	250c.c.	44.4039	44.4655	.0616	.0589
19.	1023.5	2100	200c.c.	44.5810	44.6192	.0382	.0391
		2100	200	44.4039	44.4417	.0378	.0387
25.	960.1	2100	200	44.4002	44.1276	.7274	.795
		2100	200	45.1675	45.8951	.7216	.789
28.	863.8	2100	200	45.1675	45.8104	.6429	.782
		2100	200	44.4002	45.0480	.6478	.787
31.	866.62	2100	200c.c.	44.3973	45.0440	.6467	.784
		2100	200	45.1590	45.8071	.6481	.785
34.	822.7	2100	200c.c.	45.1520	45.8648	.7128	.909
		2100	200c.c.	44.3946	45.1065	.7119	.909

Ash

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Total amount of wt.	Amt. of sol. used	Wt. of Pt. dish	Pt. dish + ash.	Wt. of ash.	% of ash.
3 A.	2024.32	2000c.c.	250c.c.	45.2074	45.3284	.1210	.048
		2000	250c.c.	40.6645	40.7813	.1178	.045
3 B.	1969.14	2000	250 C.c.	44.4306	44.5032	.0726	.031
		2000	250c.c.	44.6052	44.6761	.0709	.029
4 A.	1925.51	2000	250	44.5973	40.6744	.0771	.032
		2000	250c.c.	44.4191	44.5082	.0891	.037
4 b.	1933.23	2000	250c.c.	44.5973	44.6542	.0569	.0237
		2000	250c.c.	44.4191	44.4783	.0592	.0242
9.	1970.30	2000	250c.c.	44.4102	44.4359	.0257	.0105
		2000	250c.c.	40.6290	40.6551	.0261	.0107
11	1661.50	2000	250c.c.	44.5930	44.6098	.0168	.0078
		2000	250C.C.	44.4102	44.4265	.0163	.0076
13.	1058.50	2000	250c.c.	45.1688	45.1821	.0133	.010
		2000	250c.c.	44.6844	44.6985	.0141	.011
15.	1009.90	2000	250c.c.	40.626	40.6402	.0142	.014
		2000	250c.c.	44.1680	45.1794	.0114	.011

Ash

in liquid after cooking potatoes.

Sample No.	Wt. of Sample	Total amount of sol	Amt. of sol. used	Wt. of Pt. dish	Pt. dish + ash	Wt. of ash.	% of ash.
17.	1040.60	2000c.c.	250c.c.	44.6852	44.7002	.0153	.0146
		2000	250c.c.	44.4039	44.4171	.0132	.0126
19.	1023.50	2000	200c.c.	44.5810	44.5903	.0093	.0095
		2000	200c.c.	44.4039	44.4126	.0087	.0089
25.	960.10	2100	200c.c.	44.4002	44.5597	.1595	.173
		2100	200c.c.	45.1675	45.3246	.1571	.171
28.	863.80	2100	200c.c.	44.4002	44.5601	.1599	.188
		2100	200c.c.	45.1675	45.3254	.1579	.186
31.	866.62	2100	200c.c.	44.3973	44.5494	.1521	.18
		2100	200c.c.	45.1590	45.3038	.1448	.173
34.	822.70	2100	200c.c.	44.3946	44.5472	.1526	.195
		2100	200c.c.	45.1520	45.3048	.1528	.195

Total Nitrogen

in liquid after cooking potato.

Sample	Wt. of sample	Tot. amt. sol.	Amt sol used	Acid used	NH_3 sol. used	NH_3 equiv to N.	Acid factor	N. factor	Wt. of N.	% of N.
3 A.	2024.32	2000	100	10c.c.	14.5	5.75	.493	.0047248	.01341	.0132
		2000	100	10c.c.	15.50	4.75	.493	"	.01108	.0109
		2000	100	10c.c.	14.60	5.65	.493	"	.01318	.0130
		2000	100	10c.c.	15.40	4.85	.493	"	.01131	.0110
2 B.	1969.14	2000	100	10c.c.	16.20	4.05	.493	.0047248	.00945	.0098
		2000	100	10c.c.	16.25	4.00	.493	"	.00923	.0097
		2000	100	10c.c.	16.80	3.45	.493	" "	.00805	.0083
		2000	100	10c.c.	16.70	3.55	.493	" "	.00838	.0086
4 A.	1925.5	2000	100	10c.c.	15.25	5.00	.493	.0047248	.01166	.012
		2000	100	10c.c.	15.60	4.65	.493	.0047248	.01085	.0112
		2000	100	10c.c.	15.40	4.85	.493	" "	.01131	.0117
		2000	100	10c.c.	15.5	4.75	.493	" "	.01108	.0114
4 B.	1933.2	2000	100	10c.c.	16.40	3.85	.493	.0047248	.00888	.0091
		2000	100	10c.c.	16.5	3.75	.493	.0047248	.00865	.0089
		2000	100	100c.c.	16.4	3.85	.493	.0047248	.00888	.0091
		2000	100	10c.c.	16.5	3.75	.493	.0047248	.00865	.0089

Total Nitrogen

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	amt sol used	Acid Used	NH_3 sol. Used	NH_3 equiv to N.	Acid factor	N. factor	Wt. of N.	% of N.
9	1970.3	2000	100	10c.c	17.60	2.65	.493	.0047248	.00572	.0059
		2000	100	10c.c	17.80	2.45	.493	.0047248	.00618	.0063
11.	1661.5	2000	100	10c.c	17.70	2.55	.493	.0047248	.00595	.0069
		2000	100	10c.c	17.60	2.65	.493	.0047248	.00618	.0071
13.	1058.5	2000	100	10c.c	22.95	.60	.425	.0047376	.0012	.0022
		2000	100	10c.c	23.10	.45	.425	"	.0009	.0017
15.	1009.9	2000	100	10c.c	23.15	.40	.425	"	.0008	.0016
		2000	100	10c.c	23.05	.50	.425	"	.001	.002
17.	1040.6	2000	100	10c.c	22.95	.60	.425	"	.0012	.0023
		2000	100	10c.c	2.95	.60	.425	"	.0012	.0023
19.	1023.5	2100	200	10c.c	22.55	1.00	.425	"	.002	.00207
		2100	200	10c.c	22.60	.95	.425	"	.0019	.00197
25..	960.1	2100	200	10c.c	5.80	17.75	.425	"	.034	.0367
		2100	200	10c.c	5.50	18.05	.425	"	.0363	.0391
28.	863.8	2100	200	10c.c	9.45	14.10	.425	"	.0284	.0335
		2100	200	10c.c	8.65	14.90	.425	"	.0299	.0353

Total Nitrogen,

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	Amt. sol. used	Acid used	NH_3 sol. used	NH_3 equiv. to N.	Acid factor.	N. factor	Wt. of N.	% of N.
31.	866.62	2100	200	10c.c.	9.65	13.90	.425	.0047376	.0065	.0314
		2100	200	10c.c.	8.10	15.45	.425	.0047376	.0311	.0366
34.	872.70	2100	200	10c.c.	6.75	16.80	.425	.0047376	.0338	.0433
		2100	200	10c.c.	6.80	16.75	.425	.0047376	.0337	.0432

Albuminoid Nitrogen,

in liquid after cooking potatoes.

Sample No.	wt. of sample	Tot. amt. sol.	amt sol req.	Acid Used	NH_3 sol. used.	NH_3 equiv. to N.	Acid factor.	N. factor.	Wt. of N.	% of N.
3 a.	2024.32	2000	100	10c.c	17.3	2.95	.493	.0047248	.00688	.0068
		2000	100	10c.c	17.20	3.05	.493	.0047248	.00712	.0071
		2100	100	10c.c	17.00	3.25	.493	"	.00758	.0075
		2000	100	10c.c			.493	.0047248	.	.
3 B.	1969.14	2000	100	10c.c	17.60	2.65	.493	.0047248	.00618	.00628
		2000	100	10c.c	17.50	2.75	.493	"	.00641	.0065
		2000	100	10c.c	18.40	1.75	.493	"	.00408	.00415
		2000	100	10c.c	18.50	1.85	.493	"	.00431	.0044
4 a.	1925.5	2000	100	10c.c	17.60	2.65	.493	.0047248	.00618	.00647
		2000	100	10c.c	17.70	2.55	.493	"	.00595	.00624
		2000	100	10c.c	17.50	2.75	.493	"	.00641	.0067
		2000	100	10c.c	17.80	2.45	.493	"	.00572	.0060
4 b.	1933.23	2000	100	10c.c	17.50	2.75	.493	.0047248	.00641	.0064
		2000	100	10c.c	17.20	3.05	.493	"	.00712	.00711
		2000	100	10c.c	17.70	2.55	.493	.0047248	.00595	.00595
		2000	100	10c.c	17.30	2.95	.493	"	.00688	.00687

Albuminoid Nitrogen

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	Amt sol req	Acid Used	NH_3 sol. used	NH_3 equiv to N.	Acid factor.	N. Factor	Wt. of N.	% of N.
9.	1970.3	2000	100	10c.c	18.05	2.20	.493	.0047248	.00513	.00523
		2000	100	10c.c	17.9	2.35	.493	.0047248	.00548	.00558
11.	1661.5	2000	100	10c.c	18.1	2.15	.493	.0047248	.00502	.00612
		2000	100	10c.c	17.9	2.35	.493	"	.00548	.00668
13.	1058.0	2000	100	10c.c	23.50	.05	.425	.0047376	.0001	.00019
		2000	100	10c.c	23.35	.20	.425	"	.0004	.00076
15.	1009.9	2000	100	10c.c	23.40	.15	.425	.0047376	.0003	.00059
		2000	100	10c.c	23.40	.15	.425	"	.0003	.00059
17.	1040.6	2000	100	10c.c	23.40	.15	.425	.0047376	.0003	.00057
		2000	100	10c.c	23.40	.15	.425	"	.0003	.00057
19.	960.1	2100	200	10c.c	23.30	.25	.425	"	.0005	.00053
		2100	200	10c.c	23.30	.25	.425	"	.0005	.00053
25.	863.8	2100	200	10c.c	22.75	.80	.425	"	.0016	.0018
		2100	200	10c.c	22.85	.70	.425	.0047376	.0014	.0016
28.	866.62	2100	200	10c.c	22.75	.80	.425	.0047376	.0016	.0019
		2100	200	10c.c	22.80	.75	.425	.0047376	.0015	.0018

Protein

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. Amt. Sol.	Amt. sol. used	Acid sol. Used	NH_3 used	NH_3 equ. to N	Acid factor	Prot. factor	Wt. of Prot.	% of Protein
3 A.	2024.32	2000	100	10c.c	17.30	2.95	.493	.02953	.0430	.0428
		2000	100	10c.c	17.20	3.05	.493	.02953	.0445	.0443
		2000	100	10c.c	17.00	3.25	.493	.02953	.0473	.0470
		2000	100	10c.c			.493	.02953		
3 B.	1969.14	2000	100	10c.c	17.60	2.65	.493	.02953	.0386	.039
		2000	100	10c.c	17.50	2.75	.493	.02953	.0401	.041
		2000	100	10c.c	18.40	1.85	.493	.02953	.0251	.0255
		2000	100	10c.c	18.50	1.75	.493	.02953	.0269	.0274
4 A.	1925.51	2000	100	10c.c	17.60	2.65	.493	.02953	.0386	.0405
		2000	100	10c.c	17.70	2.55	.493	.02953	.0372	.0390
		2000	100	10c.c	17.50	2.75	.493	.02953	.0401	.042
		2000	100	10c.c	17.80	2.45	.493	.02953	.0358	.0354
4 B.	1933.23	2000	100	10c.c	17.50	2.75	.493	.02953	.0401	.042
		2000	100	10c.c	17.20	3.05	.493	.02953	.0445	.0465
		2000	100	10c.c	17.70	2.55	.493	.02953	.0372	.039
		2000	100	10c.c	17.30	2.95	.493	.02953	.0430	.045

Protein

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	Amt sol. used	Acid Used	NH_3 sol. Used	NH_3 equiv to N	Acid factor	Protein factor	Wt. of Prot.	% of Prot.
9.	1970.30	2000	100	10c.c	18.05	2.20	.493	.02953	.0321	.0322
		2000	100	10c.c	17.90	2.35	.493	.02953	.0343	.0334
11.	1661.50	2000	100	10c.c	18.10	2.15	.493	.02953	.0313	.0375
		2000	100	10c.c	17.90	2.35	.493	.02953	.0343	.0412
13.	1058.50	2000	100	10c.c	23.50	.05	.493	.02953	.0006	.0012
		2000	100	10c.c	23.35	.20	.493	.02953	.0025	.0047
15.	1009.90	2000	100	10c.c	23.40	.15	.493	.02953	.0019	.00376
		2000	100	10c.c	23.40	.15	.493	.02953	.0019	.00376
17.	1040.60	2000	100	10c.c	23.40	.15	.493	.02953	.0019	.0036
		2000	100	10c.c	23.40	.15	.493	.02953	.0019	.0036
19.	1023.50	2100	100	10c.c	23.30	.25	.493	.02953	.0031	.0030
		2100	100	10c.c	23.30	.25	.493	.02953	.0031	.0030
25.	960.10	2100	100	10c.c	22.75	.80	.493	.02953	.010	.0109
		2100	100	10c.c	22.85	.70	.493	.02953	.0087	.0096
28.	863.80	2100	100	10c.c	22.75	.80	.493	.02953	.010	.0120
		2100	100	10c.c	22.80	.75	.493	.02953	.0094	.0113

Protein

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	Amt sol req.	Acid Used	NH_3 sol. used	Equiv. sol. NH_3.	Acid factor.	Protein factor.	Wt. of Prot.	% of Protein
31.	866.62	2100	200	10c.c	22.75	.80	.425	.02961	.0100	.0119
		2100	200	10c.c	22.85	.70	.425	.02961	.0087	.0103
34.	822.70	2100	200	10c.c	2.70	.85	.425	.02961	.0106	.0136
		2100	200	10c.c	22.80	.75	.425	.02961	.0094	.0121

Amido Nitrogen

in liquid after cooking potatoes.

Sample No.	Weight of Sample.	Total amount of Sol.	Amt. sol. used	Av. wt. of Total N.	Average weight Album N.	Av. weight Amido Nitrogen.	% of N. as Amido
3 A.	2024.32	2000	100	.01240	.00719	.00521	.0052
3 B.	1969.14	2000	100	.00885	.00525	.0036	.0036
4 A.	1925.51	2000	100	.01123	.00607	.00516	.0057
4 B.	1933.23	2000	100	.00877	.00659	.00218	.0021
9.	1970.30	2000	100	.00595	.00531	.00014	.0006
11.	1661.50	2000	100	.00606	.00525	.00081	.0008
13.	1058.50	2000	100	.00105	.00025	.00080	.00155
15.	1009.90	2000	100	.0009	.0003	.0006	.0012
17.	1040.60	2000	100	.0012	.0003	.0009	.0017
19.	Lo23.50	2100	200	.0020	.0005	.0015	.0015
25.	960.10	2100	200	.03515	.0015	.0337	.0354
28.	863.80	2100	200	.02915	.00155	.0276	.029
31.	866.20	2100	200	.0288	.0015	.0273	.029
34.	862.70	2100	200	.03375	.0016	.0322	.034

Starch

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Tot. amt. sol.	Amt. of sol used	Wt. of cruc- ible.	Cruc- ible + CuO.	Wt. of CuO.	Wt. of Cu.	Cu. as Red. Subst	Wt. of Starch	% of Star- ch
13.	1058.50	2000	100c.c	8.3519	8.4195	.0676	.0541	.0650		
		2000	100c.c	6.7403	6.7881	.0478	.0382	.0736		
15.	1009.9	2000	100c.c	5.7034	5.7491	.0457	.0365	.0148	.0107	.021
		2000	100c.c	6.6916	Lost	Lost	Lost	.0176	.0094	.019
17.	1040.6	2000	100c.c	6.6383	6.6916	.0538	.0426	.0236	.0095	.018
		2000	100c.c	5.9063	5.9434	.0371	.0296	.0218		
19.	1023.5	2100	200c.c	6.9228	6.9708	.0480	.0380	.0094	.0126	.013
		2100	200c.c	7.0767	7.1161	.0394	.0312	.0051	.0142	.014
25.	960.10	2100	200c.c	8.0943	8.6898	.5945	.4745	.1508	.1462	.159
		2100	200c.c	8.0443	8.6483	.6040	.4820	.1849		
28.	863.80	2100	200c.c	8.4552	9.0528	.5976	.4769	.1251	.1642	.195
		2100	200c.c	8.1562	8.7456	.5894	.4702	.1290		
31.	866.62	2100	200c.c	8.4699	9.0743	.6043	.4822			
		2100	200c.c	6.0324	6.6225	.5901	.4703	.1587	.152	.18
34.	822.70	2100	200c.c	7.6914	8.2962	.6048	.4826			
		2100	200c.c	7.4830	8.1015	.6185	.4936	.1827	.1436	.18

Direct Reducing Substances

in liquid after cooking potatoes.

Sample No.	Wt. of sample	Amt. of sol.	Amount sol. used	Wt. of crucible	Crucible + CuO.	Wt. of CuO.	Wt. of Cu.
9.	1970.30	2000	100c.c.	7.2373	7.2916	.0543	.0434
		2000	100c.c.	6.4341	6.4855	.0514	.0411
11.	1661.50	2000	100c.c.	8.1218	8.1502	.0284	.0227
		2000	100c.c.	8.3978	8.4249	.0271	.0217
13.	1058.50	2000	100c.c.	6.0314	6.1137	.0813	.0650
		2000	100c.c.	6.5985	6.6903	.0918	.0736
15.	1009.90	2000	100c.c.	6.0320	6.0505	.0185	.0148
		2000	100c.c.	7.4330	7.4550	.0220	.0176
17.	1040.60	2000	100c.c.	8.3542	8.3838	.0296	.0236
		2000	100c.c.	7.8409	7.8682	.0273	.0218
19.	1023.50	2100	200c.c.	6.7932	6.8052	.0120	.0094
		2100	100c.c.	6.4549	6.4614	.0065	.0051
25.	960.10	2100	200c.c.	6.0326	6.2216	.1890	.1508
		2100	200c.c.	7.6286	7.8603	.2317	.1849
28.	863.80	2100	200c.c.	7.6929	7.8497	.1566	.1251
		2100	200c.c.	7.6616	7.8232	.1616	.1290

Direct reducing Substances.

in liquid after cooking potatoes.

Sample No.	sample	Amt. of sol.	Amt. of sol. used	Wt. of crucible	Crucible + CuO	Wt. of CuO.	Wt. of Cu.
31.	8[illegible]5.2	2100	200c.c.	6.6436	6.8392	.1956	.1562
		2100	200c.c.	7.6939	7.8834	.1895	.1512
34.	822.7	2100	200c.c.	7.7663	7.9892	.2229	.1779
		2100	200c.c.	6.1545	6.3882	.2337	.1875

Complete Analysis

of liquid after cooking potatoes.

Calculated to % in fresh sample.

Sample No.	Total Solids.	Ash.	Total Nitrogen	Albumin N.	Protein	Amido-Nitrogen	Starch
3 A.	.152	.048	.0131	.0070	.0435		
	.151	.0465	.0115	.0075	.0470	.0052	
3 B.	.061	.030	.0098	.00644	.0404		
	.0626	.029	.0085	.00428	.0264	.0036	
4 A.	.046	.032	.0116	.00636	.0397		
	.044	.037	.0115	.0061	.0385	.0051	
4 B.	.049	.0237	.0091	.00615	~~.00616~~ .0432	[illegible]	
	.049	.0242	.0089	.00699	.042	.0021	
9.	.049	.0105	.0059	.00523	.0322		
	.049	.0107	.0063	.00558	.0334	.0006	
11.	.047	.0078	.0069	.00612	.0375		
	.0455	.0076	.0071	.00688	.0412	.0008	
13.	.0411	.010	.0022	.00019	.0012		
	.0416	~~.0017~~ .011	~~.00076~~ .0017	~~.0047~~ .0076	~~.0016~~ .0047	.0016	
15.	.0388	.014	.0016	.00059	.00376	[illegible]	.021
	.0381	.011	.0020	.00059	.00376	.0012	.019

Complete Analysis of liquid after cooking potatoes.

Calculated to % in fresh sample.

Sample No.	Total Solids.	% of Ash.	Total N.	Albumin N.	Protein	Amido-Nitrogen	Starch
17.	.0600	.0146	.0023	.00057	.0036		.018
	.0589	.0126	.0023	.00057	.0036	.0017	
19.	.0391	.0095	.00207	.00053	.003		.014
	.0387	.0089	.00197	.00053	.003	.0015	.013
25.	.795	.173	.0367	.0013	.0109		.159
	.789	.171	.0391	.0018	.0096	.035	
28.	.782	.188	.0335	.00165	.0120		.195
	.787	.186	.0353	.0019	.0113	.029	
31.	.784	.18	.0314	.00189	.0119		.18
	.785	.173	.0366	.00165	.0103	.029	
34.	.909	.195	.0433	.00218	.0136		.18
	.909	.195	.0432	.00192	.0121	.034	

A Plant Analysis of the Potato.

After the completion of the work upon the effects of cooking on potatoes, a plant analysis was under taken.

Determinations of Nitrogen in its various forms, fat, ash, and starch in potatoes are very numerous but the field of the proximate plant analysis is almost untouched.

The method used in this investigation was based upon the method outlined by Parsons and published first in 1880 and also found in Prescott's Organic Analysis. This outline was slightly changed and extended in a few particulars. The method in detail is given below.

Preparation of Sample.

A sample of good Burbank potatoes was thoroughly cleaned. An accurately weighed amount was sliced finely, dried in an oven until brittle and then weighed again. The loss is water. This air-dried sample is finely ground and preserved in a Mason jar.

The first analysis was complete in the main points but the details of separation were not performed. In the second analysis only the 80% alcohol and water extracts were investigated in as detailed a manner as possible in the time.

Moisture.

A sample of 10 to 20 grams of the air-dried substance was weighed out in an extraction tube and heated in a current of hydrogen for eight hours at 103° to 105° C. The loss in weight represents water.

BENZENE EXTRACT.

A sample of ten to twenty grams was extracted six hours in a Soxhlet extraction tube, the substance being placed in a glass having a hardened filter paper firmly wired to the lower end. This tube is

placed within a similar one thereby making it almost impossible for any solid particles to pass through into the extraction flask below.

Total Benzene Extract- After complete extraction the benzene solution was evaporated, weighed and recorded as total benzene extract. This extraction may contain: 1.volatile oils, 2. resins, 3. camphors, 4. volatile or non volatile organic acids, 5. wax, 6. solid fats, 7. fixed oils, 8. lecithin, 9. chlorophyl, 10. other colors, 11. volatile or fixed alkaloids, 12. glucosides, but almost no ash.

Volatile matter- To the weighed ex ract 15-20c.c. water was added and again evaporated on the water bath. It was dried in an air bath at 104 - 105°C. for one hour, weighed, heated again for fifteen minutes and weighed repeating thus until weight was constant. In absence of other vaporizable matter the loss of weight approximates the volatile oils.

Soluble in Water- The residue was then treated with 15-25c.c. of warm water, allowed to stand until cool and filtered. It was then washed well with cool water, the filtrate diluted to 100c.c. and divided into two equal parts. In one half of the aqueous extract the organic matter and ash was determined and the remaining part tested with special reagents for alkaloids, glucosides and organic acids.

Soluble in dilute hydrochloric acid- The residue remaining was next removed by redissolving from the filter with benzene, then evaporated, dried in the oven and weighed. The residue thus obtained was treated with warm very dilute hydrochloric acid (about 1/25 normal) allowed to cool, and filtered. The amount extracted by

acid, if any, to be decided by weighing the still undissolved residue. The acid filtrate was tested for alkaloids with Meyer's reagent and for glucosides with Fehling's solution after boiling with acid.

Soluble in 80% Alcohol- This residue was treated with several portions of 80% alcohol allowing at least an hour for each treatment. It was then filtered and the amount dissolved was determi ned by evaporation of an aliquot part of it. This may consist of chlorophyl and one or more resins. The remainder of the alcoholic solution was shaken with pulverized animal charcoal, allowed to stand some time and another aliquot portion filte ed off, evaporated and weighed. The difference between the weight of this portion and that of the former equals the amount removed by animal charcoal, consisting of the chlorophyl and perhaps resins.

Insoluble- The substances undissolved in 80% alcohol were removed from the filter, evaporated, dried and weighed. They may be fixed oil, solid fat, wax and very rarely a resin.

80% ALCOHOL EXTRACT.

The part of the plant not dissolved by benz ne after drying at 105° C. was exhausted by alcohol in the Soxhlet extractor as before, allowing 16 hours to 20 hours.

Total alcohol extract- The alcoholic solution was concentrated filtered made up to a definite volume(250c.c.) 25c.c. of this was evaporated and dried at 104-105° C. for weight of organic matter and ash in alcohol extract. This residue was ignited and the ash weighed, the organic matter being found by difference.

Soluble in water- A second portion of 25 c.c. was evaporated nearly to dryness to remove all alcohol, treated with water, digested and filtered. The filtrate and washings evaporated and dried gives weight of organic matter and ash soluble in water. The residue being ignited for weight of ash, the organic matter is determined by difference again.

A. SOLUBLE IN ABSOLUTE ALCOHOL. The remaining aliquot part (200c.c.)of clear alcoholic liquid was then evaporated to dryness on the water bath, dried in a water oven at 100° and weighed. This residue was then pulverized and treated with 50c.c. cold absolute alcohol allowing to stand at least 30 minutes with frequent stirring decanting the clean liquid on a filter. This was repeated and washed until the filtrate amounted to 350c.c. which was then concentrated to 250c.c. An aliquot portion of 25 c.c. of this solution was evaporated in a weighed platinum dish and dried to constant weight.

a. Soluble in water. The remainder of the alcoholic liquid was then evaporated nearly to dryness, a little water added and evaporated again nearly to dryness repeating this to make sure all alcohol was removed. Water was added, then filtered and washed, diluting to definite volume. To determine the amount soluble in water a measured quantity was taken, evaporated and dried at 100-102° in an air bath until constant in weight.

a' Precipitated by sub-acetate of lead- To the remainderof the aqueous solution was added basic acetate of lead which precipitated tannin, most organic acids, some extractives and some inorganic acids of the ash. This lead precipitate was collected in a Gooch filter, dried in the air bath and weighed, ignited and weighed

again, the difference of these two weights being taken as organic matter precipitated by sub-acetate of lead.

a'' Not precipitated by sub-acetate of lead- There may be in the solution from above and not precipitated by subacetate of lea d, alkaloids and glucosides, some extractives, and colors. This was determined by difference, subtracting the weight of the organic matter that is precipitated by lead subacetate from the weight known to be in the water solution in the first place.

b. Insoluble in water- The material remaining in the vessel and on the filter was dissolved in alcohol, the solution evaporated to dryness, dried in the oven and weighed again when constant.

b' Soluble in dilute hydrochloric acid- Very dilute HCl (about 1/100 normal) was used in this extraction. The solution may contain alkaloids, glucosides rarely and some extractives the weight was determined by evaporating the acid filtrate and weighing.

b'' Insoluble in dilute hydrochloric acid- The material was then removed from the filter with alcohol, evaporated, dried and weighed.

b''' Soluble in dilute ammonium hydrate- The residue was then treated with water containing a li tle ammonia(1-50) as long as anything was removed. The liquid contains acid resins and some colors. The weight was determined by evaporation of the solution, drying and weighing.

b'''' Insoluble in dilute ammonium hydrate- The material was once more removed from the filter with alcohol, evaporated dried and weighed. This residue may include neutral resins, some colors and albuminoids(in seeds).

B. INSOLUBLE IN ABSOLUTE ALCOHOL. (from portion by 80% alcohol)

c. Soluble in water- The insoluble residue was dried and weighed, then treated with water filtered and washed thoroughly with water.

c' Precipitated by basic acetate of lead- This includes some colors, extractives, albuminoids(rarely) organic and inorganic acids. The precipitate in filter is washed dried, and weighed in a Gooch-crucible. After igniting it was weighed again the lo s being considered as organic matter precipitated.

c'' Not precipitated by sub acetate of lead- This may include alkaloids, glucosides, glucose, sucrose, and some extractives. The weight is determined by difference between (c) and (c'). This lead in excess was removed from the solution by precipitation with sodium carbonate, and glucose and sucrose determined by method s to be described later.

d. Insoluble in water- The residue was dried and weighed.

d' Soluble in dilute hydrochloric acid- This may consist of alkaloids or glucosides and the amount was determined by evaporating drying and weighing the filtrate.

d'' Insoluble in dilute hydrochloric acid- This may consist of a few resins some extractives and color substances. The residue from d' after removing from the filter with alcohol was evaporated dried and weighed.

COLD WATER EXTRACT.

That part of the plant remaining insoluble after treatment with alcohol was dried at 104°c. and completely extracted with cold water by stirring with water in a beaker and allowing to macerate for some time, 24 hours at least.

The washing and filtering was performed by use of the filter pump placing the substance on a piece muslin stretched over a perforated disk in a funnel. After thoroughly washing the residue, making up the filtrate to definite volume(1 litre), 100c.c. was evaporated to dryness, dried and weighed, then ignited for ash, organic matter being determined by difference. This portion may contain gum, salts of organic acids rarely a substance like dextrin and small amounts of albumenous substances and coloring matter.

ACID EXTRACT.

After extracting with cold water, the substance remaining was dried and weighed. It was then transferred to a beaker containing 500 c.c. of water and 5 c.c. concentrated H_2SO_4 and boiled for 6 hrs. replacing the water from time to time so as to maintain the same volume. This treatment converts starch into dextro-glucose. The acid digestion removes occasionally some salts of organic acids with usually traces of albumenous and undeterminate substances. The insoluble substance was filtered and washed with water . The filtrate and washings were boiled with an excess of barium carbonate. The last traces of acid were neutralized with a little baryta water. Filtered and concentrated the solution to 50c.c. and obtained the specific gravity by a 50c.c. specific gravity bulb. The excess above 1000 was divided by 8 and thus it gives us the weight of starch in the original sample. The addition of tannin to the original solution gives a white or buff precipitate if albuminoids are present.

ALKALI EXTRACT.

The residue from the treatment with acid was well washed and dried at110° and its weight recorded. Then this residue was boiled for two hours with 500c.c. of a solution containing 20 grams of NaOH

to the liter. In order to prevent breaking of the vessel by bumping the operation was carried on in a round bottomed flask of a liter capacity, and to prevent foaming a blast of air was conducted to the flask and blown on the surface of the liquid. The residue was was then washed on muslin as in the prec eding determinations, with hot water until the filtrate tested free from alkali, transferred to a weighed dish, dried at 110-112° to constant weight. This weight subtracted from the previous one shows the total alkali extract. This extract is largely albumenous matter and various modifications of pectic acid.

CRUDE FIBER

The residue non remaining from these various extracts is termed "crude fibre".

After drying and weighing, the crude fibre was washed with 51/2 % Br. solution. Allowed the Br. water to stand in the cellulose for twelve hours, then washed and boiled with 1/5 % NH_4OH and filtered. Repeated this treatment until the cellulose was white. The residue was washed again free of alkali, dried and weighed as cellulose and ash. It was then transferred to a platinum dish and ignited for weight of ash. The ash deducted from the previous weight gives cellulose.

The loss in weight by this treatment with chlorinated soda solution is considered as lignose and coloring matter.

In the following pages the results of the plant analysis is discussed. The first sample was treated with all the extractive media but the minor separations were sometimes omitted or hastily and inaccurately done. The separation of the 80% alcohol extract particularly is very incompletely done. In the second determination the intention was to investigate the 80% alcohol and water extracts more completely than in the first case. The benzene extraction had to be done but no attempt at a separation was made. The extraction was not to be carried beyond the treatment with water.

Discussion of Results.

Benzene Extract: The benzene extract is supposed to include fat and other substances not included in the ether extract from foods.

Total Benzene Extract.

I.	II.
.34%	.36%

As obtained from potatoes the benzene extract is a brownish amorphous mass which is only slightly gummy. As will be seen it amounts to quite the same as the ether extract.

Volatile Benzene Extract.

I.	II.
.22%	

In the second determination the benzene extract was not separated. The nature of the volatile part of the extract has not been investigated.

Fixed Oils and Fats.

I.	II.
.13	

The non-volatile part of the extract is not affected by water, dilute acid or 80% alcohol and is therefore regarded as fixed oils and fats.

80% Alcohol Extract.

I.	II.
8.63%	12.03%

The great difference in the results in the first and second determinations is due probably to incomplete extraction in the first one. It was only extracted ten hours while the second was extracted twenty hours. All the first separations of the alcohol extract are uncertain and rather carelessly done.

Total Organic Matter.

I.	II.
7.88%	10.36%

The organic matter consists of sugars of various kinds, resins glucosides perhaps tannins and organic acids.

Ash.

I.	II.
.75	1.67

The difference in ash is even greater than in organic matter. The second one amounts to about two-fifths of the whole ash contained in the potato.

Organic matter Soluble in water.

I.	II.
7.17%	8.64%

Ash soluble in Water.

I.	II.

.70% 1.54%

A slight portion of the ash is evidently soluble in alcohol and insoluble in water.

Portion soluble in Absolute Alcohol.

II. II.

1.84%

In the first determination the loss by treating was not estimated directly as in the second case. Some of the portion dissolved is probably due to the water collected by the solvent, the dishes etc. during the process of washing and filtering.

WATER SOLUBLE.

Absolute Alcohol Solution
precipitated by Basic Lead Acetate.

I. II.

.20% .06%

The attempted separation by precipitation with basic acetate of lead is very unsatisfactory. The manipulation of the process is very difficult. It is impossible to tell when the filtration is complete for the acetate itself precipitates when in contact with the air. The matter precipitated consists of tannin organic acids, etc.

WATER INSOLUBLE RESIDUE FROM ABSOLUTE ALCOHOL SOLUTION.

Soluble in HCl.

I. II.

.22%

The residue soluble in HCl was entirely missing in the first case. This residue consists of glucosides or perhaps an alkaloid.

RESIDUE FROM ABSOLUTE ALCOHOL SOLUBLE IN WATER. PRECIPITATED BY BASIC LEAD ACETATE.

I.	II.
.52%	1.48%

As previously stated the basic lead acetate of lead precipitation is very unsatisfactory. The matter precipitated is probably colors and organic acids.

Glucose.

I.	II.
.04%	1.48%

The glucose is contained in the filtrate from the basic lead acetate precipitate in the water solution from the portion insoluble in absolute alcohol. Some kind of a mistake occurec in the first determination. The second is far more reliable.

Sucrose and Glucose.

I.	II.
.75%	1.35%

This analysis shows the combined amounts of glucose and sucrose From the second analysis which is the only reliable one it would appear that the glucose or other reducing sugars are the only ones present.

Water Extract.

The water extract contains protein, ash and soluble starch.

Total Water Extract.

I.	II.
7.97%	6L70%

The high per cent of the first determination is due probably

to substances soluble in alcohol but not taken out in this case due to incomplete extraction, with 80% Alcohol.

Total Organic Matter.

I.	II.
4.62	4.34

This consists of protein and soluble starch. From the agreement of the two determinations it would seem that the difference in the total water extract is due mostly to difference in per cent of ash. Apparantly a little over a per cent of ash soluble in alcohol was not extracted in the first case.

Ash .

I.	II.
3.35%	2.36%

The difference in per cents of ash in the two determinations confirm the statements made in the above separation.

SOLUBLE STARCH.

I.	II.
	3.36%

It was found that the water solution must be acidified before the starch test with iodine became visible. This was found out in the first case.

Protein.

I.	II.
2.28%	1. 7%

The protein obtained in this extract amounts to only about one third of the amount of protein obtained in the ordinary analysis of potatoes.

Total Acid Extract.

This extract contains all the starch not dissolved by the water No albuminoids seem to be present.

Starch.

I.

86.78%

This extract is by far the largest in the whole analysis amounting to nearly seven eights of the whole substance. Starch is however not the only body dissolved here. The pentosans would be dissolved here and determined with the starch.

Cellulose and Lignin.

I.

1.84%

The alkali extraction takes out no appreciable per cent of matter. The residue consists of cellulose and lignin and colors.

Lignin.

I.

31.

The treatment with Br. water and NH_4OH takes out the lignin and colors.

Cellulose.

I.

1.53%

The cellulose is the residue unaffected by the various preceeding extractions. It should be nearly white and somewhat fibrous in appearance.

Approved June 17th, 1901
Arthur W. Palmer